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HunterNet
THE COMPETITIVE EDGE IN ENGINEERING

AUSTRALIAN INDUSTRY GROUP

TAFE NSW
HUNTER INSTITUTE

THE UNIVERSITY OF NEWCASTLE AUSTRALIA

REPORT

Hunter Manufacturing and Engineering Skills Project

A review of the skill set requirements of small and medium enterprises arising from new and emerging technologies

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EXECUTIVE SUMMARY

The objective of the Hunter Manufacturing and Engineering Skills project was to identify the new and emerging technologies that are being adopted by manufacturing and engineering businesses in the Hunter Region, and the required skills sets arising from those technologies. The focus of the project was on small and medium enterprises (SMEs) and aimed to understand the integration of technologies into those businesses.

The Hunter Manufacturing and Engineering Skills Project is an initiative funded by the New South Wales Department of State and Regional Development (DSRD), University of Newcastle, TAFE NSW – Hunter Institute, and HunterNet Co-Operative Limited, and supported by the Australian Industry Group.

The project involved an exploratory phase, a series of focus groups, and a survey to identify the perceptions of employers regarding the effects of technology on the skill requirements for their workforce. With the assistance of HunterNet and the Australian Industry Group, the survey was issued to 206 manufacturing and engineering companies in the Hunter Region. 21% of these businesses responded to the survey.

Key Findings

The Hunter Manufacturing and Engineering Skills Project identified that a number of technologies, at different stages of maturity, have been recently adopted by Hunter Region SMEs, and are expected to continue to be important in the future. These include the relatively mature technologies of three-dimensional computer-aided design (3D CAD) and computer numerically controlled machining (CNC), and the new and emerging technologies relating to sensors, embedded control systems and automation.

One of the key findings of the report was that the perception of new and emerging technologies by a business translates directly into perceptions of skill requirements, satisfaction with training courses, understanding of customer requirements and engagement in sustainability. Based on responses to the survey, two groups of companies were identified: “Tech-enabled” companies, and “Conservative” companies.

The survey showed that companies that are Tech-enabled are more aware of emerging technologies and are more satisfied with their engineering staff, particularly in terms of their level of innovation and understanding of technology. Tech-enabled companies are more aware of changing customer requirements, and more likely to be providing an extended range of products and services. These companies identified converging skills, and the skills associated with competitive and lean manufacturing, as being important to their business in the future. Tech-enabled businesses indicated that training for their trade-based staff did not reflect their current manufacturing capabilities, or produce tradespeople who were aware of the latest technologies.

The group of companies described as Conservative in this report do not perceive themselves as employing new and emerging technologies, although all but one had employed at least one of the technologies identified in this project. In general, Conservative companies do not consider the technologies that they are using “high tech”. They are satisfied with the skills of recently qualified tradespeople and expect the skills possessed by these tradespeople to meet their trades-based skilling requirements for the next 5-10 years. They are less satisfied with the skill-levels of university graduates than the Tech-enabled companies.

Regardless of the level of adoption of technology, all businesses who participated in the survey believe that tradespeople and engineers alike do not emerge from training with a sufficient understanding of business operations, and that recent engineering graduates are generally not regarded as being able to produce practical solutions.

Recommendations arising from the report:

Based on the results of this project, the main priorities for training providers to support the skill requirements arising from emerging technologies are:

- Ensure that training adequately provides the core and practical skills required for trade-based, para-professional and professional personnel;
- Develop processes that will allow training facilities and programs to expose students to the newer technologies in their respective fields;
- Develop courses that deliver the skill requirements relevant to the technologies employed by Tech-enabled companies;
- Develop programs and resources that support Conservative companies to enhance their knowledge of new and emerging technologies and the adoption of those technologies;
- Develop complementary training programs for both trade and university graduates in:
  - product costing;
  - production management;
  - business skills; and
  - innovative manufacturing practices (e.g. lean manufacturing and competitive manufacturing).
- Develop closer ties between SMEs and the trade-based training providers; and
- Ensure linkages between training organisations provide pathways for supplementary skill training, as required by Hunter Region SMEs.

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1. INTRODUCTION

The Hunter Region has a long and successful history associated with manufacturing and engineering businesses. In the Hunter Region there are over 2000 small and medium manufacturers who contribute to the economic and social sustainability of the region. In the past decade, advances in technologies have affected business operations in a number of areas, including design capabilities, production control, computer control systems, advanced materials and electrotechnologies.

New technologies are introduced into manufacturing and engineering businesses for a number of reasons, including improved efficiencies, to meet customer requirements, and for some companies, to enable innovations. The objective of this report is to identify the technologies and emerging skill sets that are impacting on small and medium manufacturing and engineering businesses in the Hunter Region. The focus of the project is on:

- Specialist manufacturing and engineering enterprises;
- The evolution of IT related processes and technology and the integration of these into specialist manufacturing and engineering enterprises; and
- Other new technologies, materials and processes emerging, or likely to emerge, as significant for SMEs in the Hunter.

In addition to these objectives, this project identified businesses' perceptions of the business and "soft skills" required to support entrepreneurial activity, and the business opportunities arising from environmental sustainability and the climate change agenda.

Advitech Pty Limited was engaged by HunterNet, on behalf of the Hunter Manufacturing and Engineering Skills Sub-Committee, to conduct the Hunter Manufacturing Skills Project. Advitech is an engineering, environmental, and information technology firm providing professional services. Based in Newcastle NSW, Advitech has expertise in a range of industry sectors including manufacturing, mining, and government. In conducting the Hunter Skills Project, Advitech applied its technical understanding, knowledge of operational contexts, and strong ties to Hunter Region manufacturing and engineering businesses to provide insight and understanding in achieving the project objectives. For the purposes of this project, Advitech utilised the skills of Enigma Communication's research division, based in Newcastle, to facilitate consultations with industry representatives.

2. BACKGROUND

The Hunter Manufacturing and Engineering Skills Project is an initiative funded by the New South Wales Department of State and Regional Development (DSRD), University of Newcastle, TAFE NSW – Hunter Institute, and HunterNet Co-Operative Limited, and supported by the Australian Industry Group.

The project is focused on the needs of small and medium enterprises (SMEs) in the development of their skill base to ensure that their industry remains competitive in metals engineering, manufacturing and electrotechnology.

These industries are generating considerable employment growth and wealth for NSW, but the long term future for all three depends upon access to a skilled workforce, and an increasing convergence of skill sets, such as the integration of information technology and skills in manufacturing, and also the requirements for strong business and entrepreneurial skills.

2.1 Manufacturing and Engineering in the Hunter Region

Manufacturing involves the transformation of raw materials or components into new products. The degree of transformation of a manufactured product may vary from 'simple' through to 'elaborate'. The Manufacturing Industry Skills Report[1] defines the classifications as follows:

- **Simply transformed manufactures** - may include products such as basic metal shapes, cement, and basic inorganic and organic chemicals.
- **Moderately transformed manufactures** - include goods such as wire rods, metal pipes and tubes, basic glass, soap and detergents, textile fabrics and tissue paper.
- **Elaborately transformed manufactures** - include goods such as pre-fabricated metal buildings, wire products, glassware, ceramic products, paints, medicines and perfumes. This group also includes a range of engineering products, transport equipment, and motor vehicles, and electronic and other equipment.

Manufacturing that involves elaborately transformed products, for example engineering products, electronic equipment, transport equipment and ceramic products, generally requires a highly skilled workforce.

The organisations consulted for the purposes of this project are those organisations that are involved in, or supporting, the manufacture of moderately or elaborately transformed products. By the nature of their manufacturing operations, these organisations generally employ a highly skilled workforce, and are exposed to technological advances in their processes, techniques and materials.

2.2 New Technologies and Emerging Skill Sets

This project was focused on discovering the emerging skill sets arising from the adoption of new and emerging technologies. The term "emerging technologies" is often used to describe the cutting and leading edge innovations. For the purpose of this project, a broader definition has been used, as described below:

> ***Emerging Technologies - new technologies that have been introduced, or are planned to be introduced, that have promising, but not necessarily fully realised, potential.***

The last five years has produced a number of studies and reports on skills gaps in manufacturing businesses, relevant to the Australian and Hunter manufacturing industries. The reports have similar themes in terms of which emerging technologies are likely to become important, with the main technologies centred on the increasing use of computers in products, operations and machinery, and services.

The 2004 report, *"Skills Shortages in the Hunter"*, was a study by the Australian Industry Group that investigated the nature and depth of skills shortages within the manufacturing, engineering, and related service sectors. The report identified that for businesses with less than 100 personnel, one third of those businesses identified skill gaps within their workforce.

The 2005 report, *"A Review of the Skills and Training Needs of the "Emerging" Manufacturing Sector on the NSW North Coast"*, by the Mid North Coast Regional Development Board, found that key skills gaps in that region were access to training in niche, non-traditional and new technology skills. Also,

[1] Department of Education, Science and Training, ***Manufacturing Industry Skills Report***, April 2007.

the report cited that skill gaps were in part due to "existing labour resources lack generic manufacturing skills".

Additionally, there are a number of reports relating to skills shortages, including *Skills in Demand Lists* by the NSW Department of Employment and Workplace Relations, and the *Manufacturing Industry Skills Report* by the Department of Education, Science and Training. Other relevant reports consulted as part of the background research for this project are listed in **Section 8 – References.**

In this report, we have used the language and descriptions of the emerging technologies used by industry representatives during the consultation process. Technologies that were included in the report included some more mature technologies, such as CNC machining and 3D CAD, as it was identified that for some Hunter Region businesses the potential of the technologies were not yet fully realised, and that skill gaps existed in these technologies.

2.3 Other Considerations

The timing of the project consultations, from March to May 2009, coincided with the initial stages of a global "financial crisis", which by May 2009 had resulted in Australia facing the prospect of a financial recession. Prior to this time businesses had been operating in a "resources boom", which had been very profitable for a number of SMEs in the region. To some extent these factors influenced the perceptions of skills gaps.

Regardless of the changed financial environment, many of the businesses who participated in the focus group sessions generally had a positive outlook for their business. With regards to recruiting skilled employees, many businesses were optimistic about their ability to find skilled employees.

A perception that was expressed by employers was that the financial environment would be likely to bring stability to the workforce due to the limited number of jobs available. Another viewpoint expressed was that the investigation of emerging technologies had not been considered in recent years, as a result of the resources boom.

> *"Why change what you're doing when all you need to do is keep up to demand?"*

2.4 Project Methodology

The Hunter Manufacturing and Engineering Skills Project is based on the perceptions of skill sets and technologies relevant to Hunter Region SMEs. The project included an exploratory stage to identify relevant reports and key issues with respect to technology and skills in manufacturing and engineering organisations, and qualitative and quantitative analyses based on a series of focus groups and an online survey.

Focus groups were used to explore how emerging technologies may be implemented into participants' business operations. The goal was to identify the perceptions of which supporting skills sets would be required, for trades-based, paraprofessional and engineering employees to meet their skill gaps resulting from emerging technologies. Representatives of seventeen Hunter manufacturing and engineering businesses were involved in the focus group sessions.

Based on the preliminary findings of the focus groups, a survey was developed and delivered to the email inboxes of over 200 small and medium businesses in the Hunter Region. The industries consulted as part of the Skills Project were identified as those companies involved in manufacturing and engineering, with a workforce of less than 150 personnel. The contact information for these businesses was based on the membership details of HunterNet and Australian Industry Group. The survey was followed-up with telephone calls to over 160 of the targeted businesses.

Of the 206 businesses targeted, 21% completed the survey. The rate of response was similar to other surveys of this type: The North Coast Survey, conducted in 2005, also had a response rate of 21%, while the Australian respondents to a 2006 international survey on "Australian Innovation in Manufacturing" had a response rate of 17%[2].

2.4.1 Survey demographics

The demographics of those businesses who responded to the Hunter Skills Project survey are described in **Figure 1**. The majority of respondents (51%) were from businesses with a workforce of between 11 and 49 personnel. 86% of all respondents had less than 100 personnel.

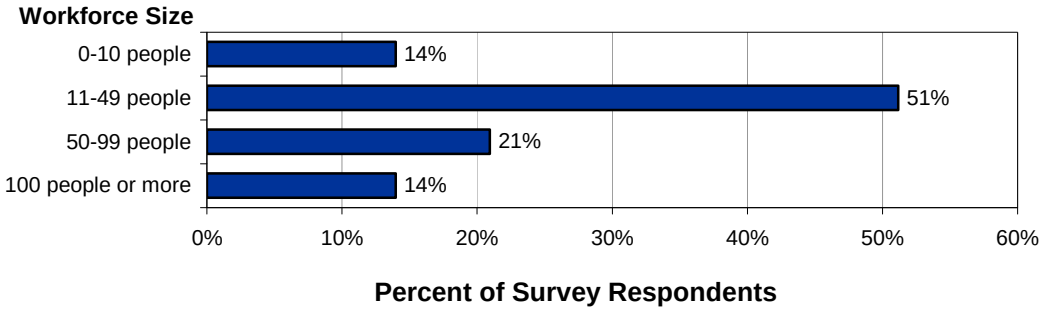


Figure 1: Workforce Size of Businesses Participating in the Survey

The businesses who participated in the survey provided a range of products and services, as described in **Figure 2.** Of the businesses who responded to the survey, 70% were involved in the manufacturing and assembly of products. Slightly less than 50% of the businesses offered component manufacturing, with a similar proportion providing maintenance and overhaul facilities.

[2] University of Queensland Business School, ***Australian Innovation in Manufacturing: Results from an International Survey***, Professor Mark Dodgson and Dr Peter Innes, July 2006.

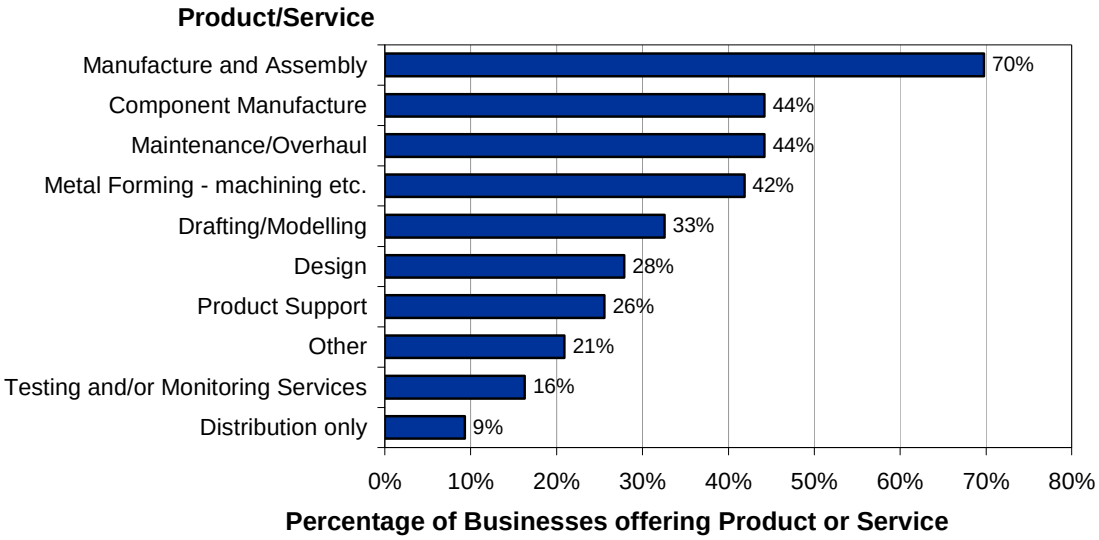


Figure 2: Products and Services of Businesses Participating in the Survey

3. EMERGING TECHNOLOGIES IN HUNTER REGION SMES

Many manufacturing and engineering SMEs in the Hunter Region are founded on traditional manufacturing techniques, such as metal casting, machining and metal-forming operations. Close to 90% of all businesses completing the survey agreed that their business uses "well established and traditional technologies".

The diffusion of new and emerging technologies into manufacturing and engineering businesses can occur in a number of ways, including:

- Incorporation of new technology or materials into existing products;
- Production of novel products and/or materials;
- Introduction of novel processing techniques;
- Adoption of technologies to aid in the design and product development phase; and
- Adoption of technologies to support business operations, e.g. maintenance systems, e-business, and logistics software.

During the focus group sessions, when asked about emerging technologies important to their businesses, the initial reaction of some employers was that they probably weren't using any.

> *"What are the new and emerging technologies? Many of us operate in our area of expertise. A lot of us don't know what the emerging technologies are and how they might be relevant to us."*

Despite the initial reactions of little or no use of new and emerging technologies by some participants, focus group discussions did however reveal that to some extent, these technologies had been introduced into most companies. Participants described, for example, the use of new materials, computer-systems for production control, advanced welding techniques, computer-aided design, and

internet-based communications. There was an overall recognition that manufacturing operations were indeed changing.

> *"Old school vs. new stuff. The whole world is shifting to the computer age."*

Some focus group participants expressed strong and well-informed views of new and emerging technologies, and how they applied to their businesses. These participants described technologies that they had recently implemented, observed at trade shows or when travelling overseas, and technologies used by larger companies operating in similar markets. Some of these employers also described new products that they were developing in their businesses that incorporated new technologies.

3.1 New and Emerging Technologies in Hunter Region SMEs

Consultations with business managers and owners during the focus groups established some main themes relating to new and emerging technologies relevant for Hunter Region SMEs. These were:

- Integration of electronic technologies into products:
  - Embedded technologies
  - Wireless communication, GPS, on-board storage
  - PLC controllers used in increasingly diverse products
- Increasing sophistication in design:
  - 3D modeling, complex CAD, CNC design
- Increasing levels of automation:
  - Computer Aided Manufacture, CNC
  - Robotics, monitoring
- Increasing use of data collection and retrieval:
  - Real-time monitoring
  - Self-diagnosing machines
  - Product traceability
- Increasing requirements for "connectivity" to integrate processes and systems

Additional themes relating to skills that support the implementation of new and emerging technologies, were also established. These skills included project management, lean manufacturing, production control and business skills.

Based on these main themes relating to the technologies, and on similar studies of emerging technologies conducted elsewhere, a list of new and emerging technologies considered to be significant for Hunter SMEs was developed. These technologies are described in **Table 1**.

Table 1: New and Emerging Technologies Relevant to Hunter SMEs

Emerging Technology	Description	Potential Benefits
3D CAD (solid modelling)	Three-dimensional computer aided design. Used for design of machinery, components, vehicles, buildings etc.	Lower product development costs and a greatly shortened design cycle.
Wireless communications	Transfer of information over a distance without the use of wires.	Remote Monitoring and reporting. Communication with remote workforce. Ability to offer "Smart Maintenance"
CNC Machining / Advanced Machining	Computer Numerically Controlled Machining. Advanced machining includes technologies such as laser, plasma and wire cutting.	Improved efficiencies, quality control and repeatability.
Advanced Welding Techniques	Advanced welding equipment incorporating computer controls, and/or electrodes. Robotic welding. Welding techniques for advanced materials.	Improved efficiencies, better control of welding – leading to better weld quality.
Embedded Control Systems	Computer control systems contained within a product that performs dedicated tasks.	Embedded systems are optimised to perform certain functions. Benefits to the manufacturer include the difficulty for competitors to replicate the specific functionality of the embedded system.
Finite Element Modelling	In a manufacturing context, FEM is numerically based modelling of the behaviour of materials, components and assemblies.	FEM helps to optimise materials and design during the design phase of products.
Advanced Techniques for Non-Destructive Testing	Non-destructive testing involves the identification of defects in materials. Advances in sensors, computational methods, and monitoring equipment are driving technology in this area.	Predictive maintenance of items. This may benefit a company's internal manufacturing operations, or be applied to products/services for competitive advantage.
Advanced Materials	Advanced materials include new alloys, composites, polymers, nanotechnology etc.	Substitution of advanced materials may provide benefits in cost, weight, and product life cycle.
Automation/Robotics	Automation is the programming of machines and equipment to perform and control certain processes. Robotics generally refers to machines capable of performing a set of mechanical tasks.	Increase efficiencies, improved quality, integration of manufacturing systems.

It is noted that some of the technologies described in **Table 1**, such as CNC machining and 3D CAD, have been available for a number of years. However, changes in the pricing and usability of the technologies are making them accessible to a wider cross-section of small and medium businesses. Similarly, advances in computational speeds, data storage and other technologies continue to change the way in which established technologies are implemented in manufacturing and engineering businesses.

The level to which the technology had been adopted, or planned to be adopted, by companies was assessed in the survey. Initially respondents were supplied a simple definition of emerging technologies:

> ***The term "emerging technologies" relates to new tools, processes or products that change the nature of work.***

Respondents were then asked to self-assess whether their business was implementing emerging technologies, with the question:

> ***Is your company currently implementing new and/or emerging technologies in your processes, products or services?***

The results, shown in **Table 2**, indicate an almost even split between those businesses who consider themselves to be employing emerging technologies, and those who don't. Subsequent analysis of the survey results revealed the response to this question to be a defining attribute of the business, as discussed further in **Section 4.1.**

Table 2: Survey Results - Implementation of New and Emerging Technologies

Statement	Yes	No	Not Sure
Is your company currently implementing new and/or emerging technologies in your process, products or services.	20 (47%)	22 (51%)	1 (2%)

For those respondents who answered "Yes", some of the technologies they cited their businesses were using were remote monitoring, use of computer systems for design and enterprise management, materials substitution, and specific technologically advanced products for non-destructive testing. A number of respondents also described lean and competitive manufacturing as a "technology" being implemented by their business.

Companies were asked to assess the list of technologies, as described in **Table 1**, with respect to the implementation of that technology in their business. The scale used was: "no plans to use/not relevant", "established technology", "recently introduced (previous two years)", and "planning to implement". The survey results are shown in **Figure 3.**

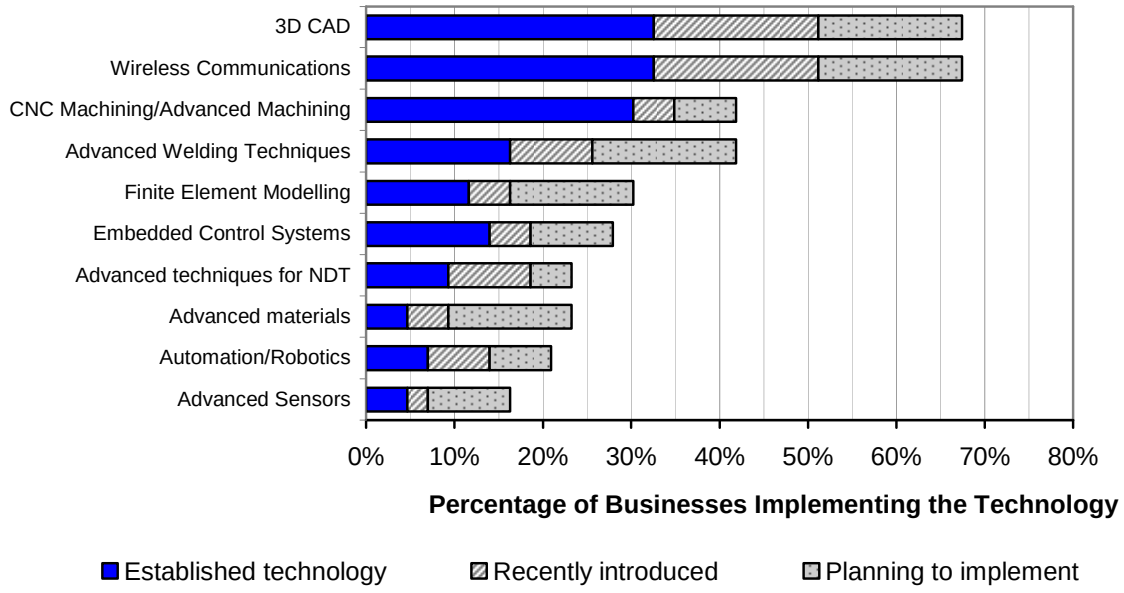


Figure 3: The Adoption of New and Emerging Technologies by Survey Participants

Of all respondents, there was only one company that had not implemented any of these technologies.

Figure 3 confirms that for each of the technologies surveyed, the full potential of the technology has not yet been fully reached. For each of the technologies included in the survey, a significant level of adoption had occurred in the last two years, and the uptake of technologies is expected to continue in the future, with businesses indicating their intentions to further adopt the technologies.

Over 50% of all companies surveyed have already integrated 3D CAD into their operations, with a third of these users having implemented the technology in the last two years. A further 16% of survey respondents plan to implement this technology in the future. The adoption of 3D CAD by businesses was high across all of the industry types surveyed. Similar rates of adoption are seen for the technologies associated with wireless communications.

CNC machining, a technology particularly applicable to businesses involved in component manufacture, is a technology that appears to be approaching maturity. Of the 19 businesses who are involved in the manufacture of components, 16 businesses (84%) had implemented or are planning to implement the technology.

Technologies such as 3D CAD and CNC machining are fast becoming industry standards, rather than being considered as new or emerging technologies. However, for some businesses these technologies are being implemented for the first time. This is illustrated in **Figure 3** which shows the significant number of businesses that have recently implemented, or are planning to implement these technologies.

Some of the most significant areas of expected growth for emerging technologies included advanced materials, automation/robotics, and advanced sensors. Currently, these technologies have a relatively low rate of adoption, with less than 5% of all business surveyed using these technologies. However, based on the survey results, the number of businesses expected to start to use these technologies will

increase to 25%, and may rise beyond that as the understanding of the technologies increase, and barriers to entry decrease.

Other technologies referred to by respondents included electro-hydraulic control systems, predictive maintenance techniques and technologies associated with bar-coding.

3.2 Drivers of New and Emerging Technologies

There are a number of reasons why manufacturing and engineering businesses implement new technologies into their products, processes and business operations. These driving forces include:

- Implementing technologies to achieve efficiencies;
- Employing new technologies to achieve competitive advantage – "staying ahead of the pack"; and
- Incorporating new technologies to meet customer expectations.

For Hunter Region SMEs who responded to the survey, over 50% of businesses agreed that new technologies were introduced to "stay ahead of the pack". A similar proportion agreed that technologies were introduced in response to customer expectations. The adoption of technologies by a company, whether by push or by pull, has implications for the skill sets required for that workforce.

> *"We are looking at a remote monitoring system, telemetry and wireless technology. ... We see technology as one of the ways to stay competitive. With that comes a realignment of the labour force."*

3.2.1 Changing customer expectations

The effects of changing customer expectations and requirements on the implementation of technologies, and subsequent skill requirements in businesses, were a common theme during focus groups sessions. The trends identified during consultations with employers included:

- Design requirements being "pushed down" the supply chain;
- Requirements for "turn-key" solutions;
- Expectations for real-time monitoring, integrated logistics, and component tracking; and
- Packaging of goods and services: inclusion of maintenance plans, training etc.

All of these trends demonstrate the increasing complexity in processes and information management required for SMEs in meeting their customer requirements. Focus group participants expressed the view that a significant portion of the overall design, and details of the integration of the products into customers' operations, is being pushed from larger organisations onto SMEs.

Increasing complexity in the supply of products and services by SMEs is driving the adoption of technologies that enable the businesses to manage support systems and processes, for example, quality, occupational health and safety, and Australian and international standards.

> *"... Not just a manufacturer – training, manufacturing, service. Manufacturers roles are expanding ... and becoming more global."*

The significance of changing customer requirements to the objectives of this project is twofold:

1. Changing customer requirements affect the skill sets required by SMEs. While not necessarily arising from the implementation of emerging technologies, the increasing complexity of customer requirements will require new skill sets in SMEs to manage that complexity.
2. Changing customer requirements will drive the implementation of some technologies – particularly in fields relating to knowledge management.

The impact of changing customer requirements on Hunter Region SMEs was assessed in the survey in terms of the provision of the service/product. The scale used was: "no plans to supply/not relevant", "established service/product", "recently introduced (previous two years)", and "planning to supply". The survey results are shown in **Figure 4**.

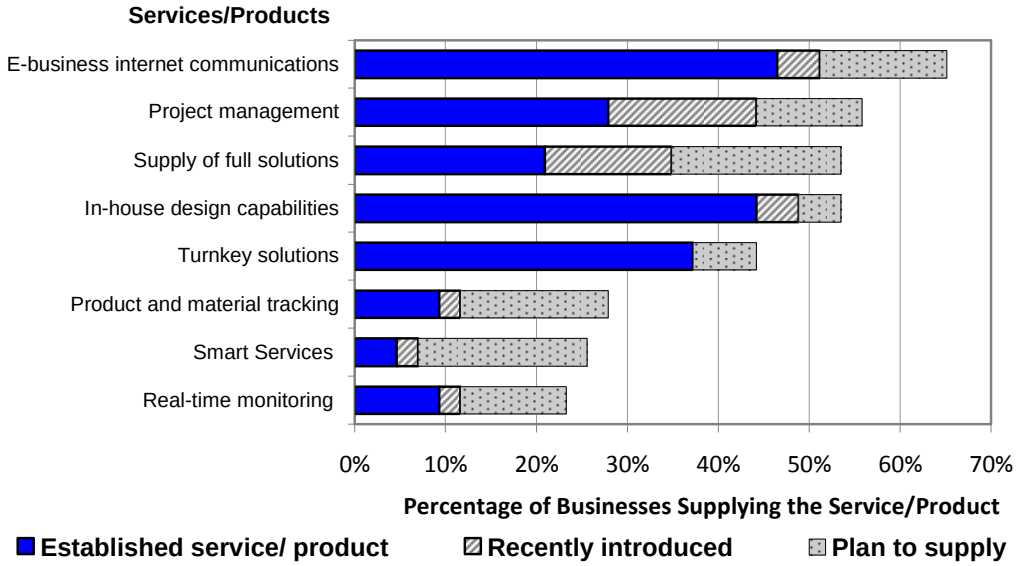


Figure 4: Changing Customer Requirements Driving Technology Adoption

The survey results indicate a continuing adoption of internet technologies and e-business, and recent growth in the requirements for SMEs to supply "full solutions" and project management capabilities. **Figure 4** also indicates that SMEs perceive that the knowledge-based technologies of product and material tracking, smart services and real-time monitoring will become increasingly important to customers.

3.2.2 E-Business is creating new business opportunities

E-business is both a cause and effect of emerging technologies. The ability to communicate with customers from around the globe has arisen from the widespread adoption and use of the World Wide Web and internet technologies. For some businesses, this technology has translated into sales in new markets in regions outside of Australia. With this increase in market size and the supply of manufactured goods to global markets, the complexity in managing standards and protocols increases.

> *"The internet is a great tool – not being used 15 years ago ...the internet makes the company more valuable for niche markets."*

The survey showed that just over 50% of the businesses surveyed have made use of the internet for e-business and communication with customers. This is typical of Australian small and medium businesses, which for all business types, have an online presence of 54%[3]. The perceptions of the skills required for e-business is discussed more in **Section 4.3.4**.

3.2.3 Increasing complexity is creating a need for project management skills

The survey results indicated that in the last two years Hunter Region SMEs have experienced a significant increase in the number of customers requiring the supply of "full solutions". In this context, a "full solution" refers to supplying not just the product, but also providing service, training, OH&S, maintenance manuals, and ongoing support. In the last two years, the proportion of businesses offering "full solutions" to their businesses has increased from 21% to 35%. The survey results indicated that this trend is likely to continue, with one in five of the businesses surveyed indicating their intention to start supplying these services.

The businesses participating in the survey describe an increasing customer requirement for project management practices in their businesses. Anecdotally, the need for project management practices arises from the requirement of project plans by customers, the increasing complexity associated with supplying full solutions, and managing customer expectations for short lead times.

3.2.4 Customers are driving the inclusion of technologies in products and services

In absolute terms, the survey indicates that the biggest growth areas for customer-driven technologies, as perceived by SMEs responding to the survey, are associated with knowledge-based technologies. In this survey they are described as "product tracking", "smart services" and "real-time monitoring".

These services describe the ability of a supplier and/or customer to collect information about manufactured goods. In the case of product tracking, associated technologies may include, for example, bar coding, databases, and smart-chips. Smart-services and real-time monitoring describe technologies that enable goods to collect, store and transmit information about their status, their operating conditions, and performance. The technologies that enable these services may include advanced sensors, embedded control systems, and wireless communications.

The survey indicates that the number of businesses planning to provide these products and services will more than double.

[3] The Sensis e-Business Report, August 2008, http://www.about.sensis.com.au

3.3 Adoption of New and Emerging Technologies and Business Attributes

A number of factors influence the adoption of new and emerging technologies, and the perceived skill sets required to utilise these technologies. These include:

- Business size;
- The industry sectors serviced by the business; and
- The existing level of innovation and adoption of technology within a business.

3.3.1 Business size

The relationship between the uptake of technology and the size of a business' workforce can be determined from the survey results, as shown in **Figure 5**. The chart shows that those technologies that may be regarded as relatively mature, such as CNC, and 3D CAD have been adopted in equal measure by both the smaller and larger companies. The more specialised, and newer technologies are favoured by companies with workforces greater than 50 personnel. It comes as no surprise that larger companies are more than twice as likely as smaller companies to have adopted, or be planning to adopt, newer technologies.

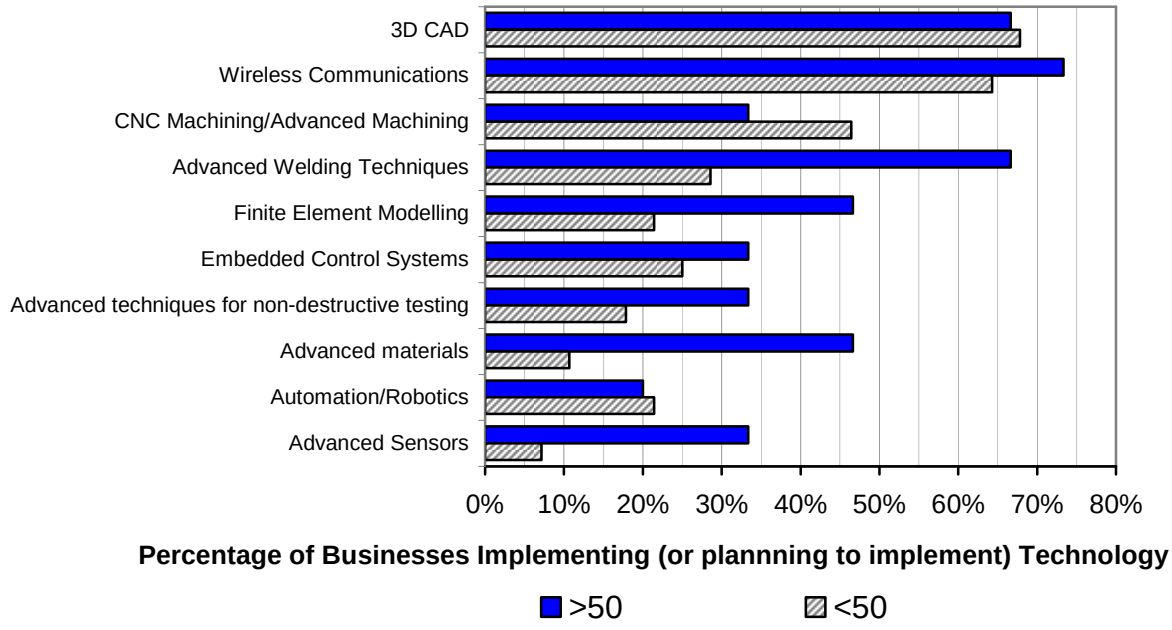


Figure 5: The Adoption of New and Emerging Technologies by Business Size

To some extent, the difference in the adoption of emerging technologies by businesses of different size may be explained in terms of the barriers to entry for that technology. Barriers to entry are those hurdles that need to be overcome in order to utilise the technology. These barriers include access to the technology, the costs associated with the technology, the skills required to use the technology, and the perceived risk associated with the technology. As technologies mature, the barriers to entry generally decrease, and the technology becomes more accessible.

For smaller businesses, new technologies may require relatively large initial capital investments, significant level of risks, and require new skills in the enterprise to use and apply the technology. The lack of economies of scale for smaller manufacturing and engineering businesses may also negate the possible advantages of increased efficiency that comes with new technologies.

The relative maturity of CNC and CAD technologies, and the relatively inexpensive technologies associated with wireless communications, are likely to have contributed to the higher adoption rates of these technologies in Hunter Region SMEs.

3.3.2 Industry type

The survey indicated that the adoption of technologies by a business was to some extent related to the industry sectors serviced by the business. In particular, those businesses that were providing products or services to the Defence Industry sector had the highest overall rate of adoption of the newer emerging technologies described in the survey. Over 85% of respondents who provide services to the Defence industry identified themselves as users of, or intending to use, 3D CAD and wireless communications. Businesses operating in this sector also had the highest rate of adoption of embedded control systems and advanced sensors.

Businesses providing services to Heavy Industry, Maritime and Food industries had the highest rate of adoption of advanced welding technologies. This can be attributed to a number of factors including the emerging technologies relating to welding advanced materials, stainless steel, and aluminium, and requirements for efficient welding processes.

3.4 The Relationship between Innovation and Adoption of New Technologies

The disparity between those companies who identify themselves as being users of technology versus those companies who have identified that they are using the specific technologies targeted in the Hunter Skills Project is shown in **Figure 6**. Of the survey respondents, 97% were using at least one of the technologies identified as significant for Hunter Region SMEs. In contrast, only 47% of the surveyed businesses identified their business as employing “new and emerging technologies”. The large difference in these measures may arise from a number of factors, including:

- The definition of what is considered to be a “new and emerging technology” is unclear;
- Technologies perceived as old or well-established by some businesses may be being used in new innovative ways by other companies; and
- Technologies that are adopted during the mature stages of development may no longer be perceived as new or emerging.

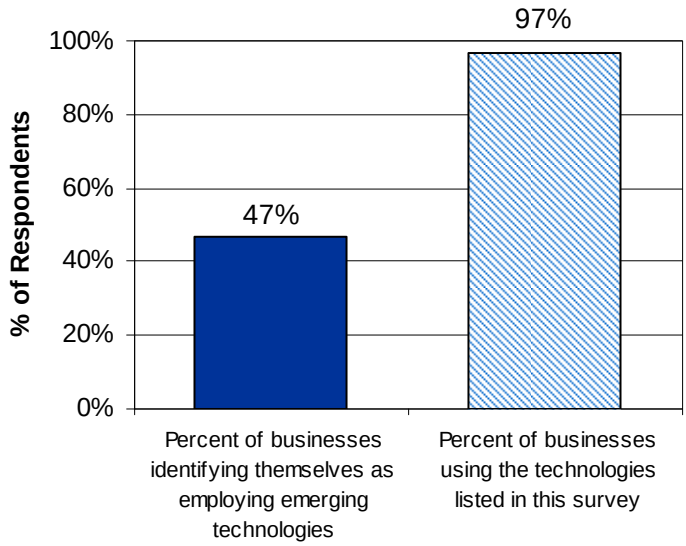


Figure 6: Perceptions of Technology Use

Regardless of the reasons for the disparity, an analysis of the survey results reveals that there is a large difference in the attitudes towards emerging technologies based on the self-assessed answer to the question "***Is your company currently implementing new and/or emerging technologies in your processes, products or services"***. The difference in attitude translates into measurable differences in the perception of the skills gaps arising from emerging technologies. The question is also able to be translated into a measure of the level of innovation in the respondent's business, as discussed in **Section 3.5**.

The gap between those companies who were aware of emerging technologies, and those companies who were not aware of emerging technologies was also apparent during consultations with employers in focus groups.

For the purposes of this report, the two groups of businesses have been described in terms of how they relate to emerging technologies. The descriptions are as follows:

- **"Tech-enabled"** – businesses who implement new and emerging technologies.
- **"Conservative"** – businesses that are more likely to adopt technologies later in the product cycle, when the products are considered more mature.

The inclusion of a business in either group is based solely on the self-assessed response to the question "***Is your company currently implementing new and/or emerging technologies in your processes, products or services***". Those companies who answered "Yes" (20 out of 43 respondents) belong to the "Tech-enabled" group, with the balance belonging to the "Conservative" group. It is noted that while companies who would be generally described as "innovative", (for example, businesses who are involved in developing the new technologies and products) would belong to the "Tech-enabled" group, not all Tech-enabled businesses are necessarily innovative.

A summary of the survey questions and responses that highlight the differences in attitude and perception of these businesses is shown in **Figure 7**.

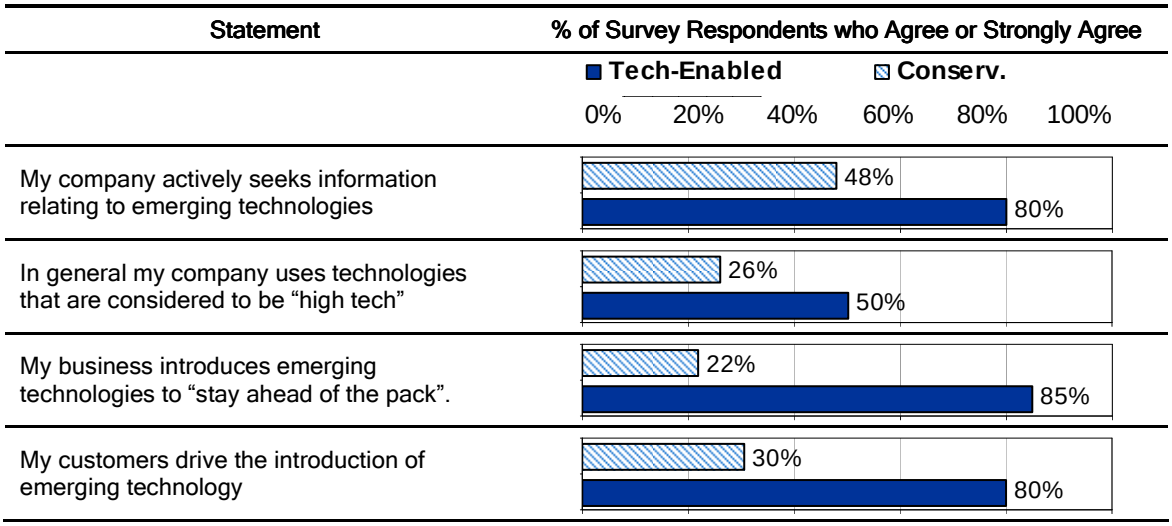


Figure 7: Perceptions of New and Emerging Technologies by Tech-enabled and Conservative Companies

Analysis of the survey questions shows that Tech-enabled companies are:

- Nearly two times as likely to be actively seeking information relating to emerging technologies;
- Two times as likely to consider their company as using "high tech" technologies;
- Three times as likely to be introducing technologies to "stay ahead of the pack"; and
- Two times as likely to perceive that their customers are driving the introduction of emerging technologies.

The attitudes towards new and emerging technologies by Conservative businesses implies that there are a significant number of Hunter Region SMEs in manufacturing and engineering businesses who operate relatively independently of new and emerging technologies: they are not using the technologies; they do not perceive that their customers are driving the introduction of the technology; and they are not introducing the technology themselves. The survey suggests that half of the Hunter SMEs fall into this category.

For Conservative businesses, it is likely that technologies are adopted when the technology is deemed to be sufficiently mature. That is, the technology is affordable, well established and relatively low risk. As expected, these companies may have implemented the more mature technologies of 3D-CAD, laser cutting or CNC machining, but are considerably less likely to have implemented technologies relating to embedded control systems, advanced sensors and advanced materials.

> *"Only technology is computer and plasma cutter. Dealing with the legacy of 30 years of fairly static growth."*

The difference in adoption of technologies of Tech-enabled and Conservative companies is shown in **Figure 8.**

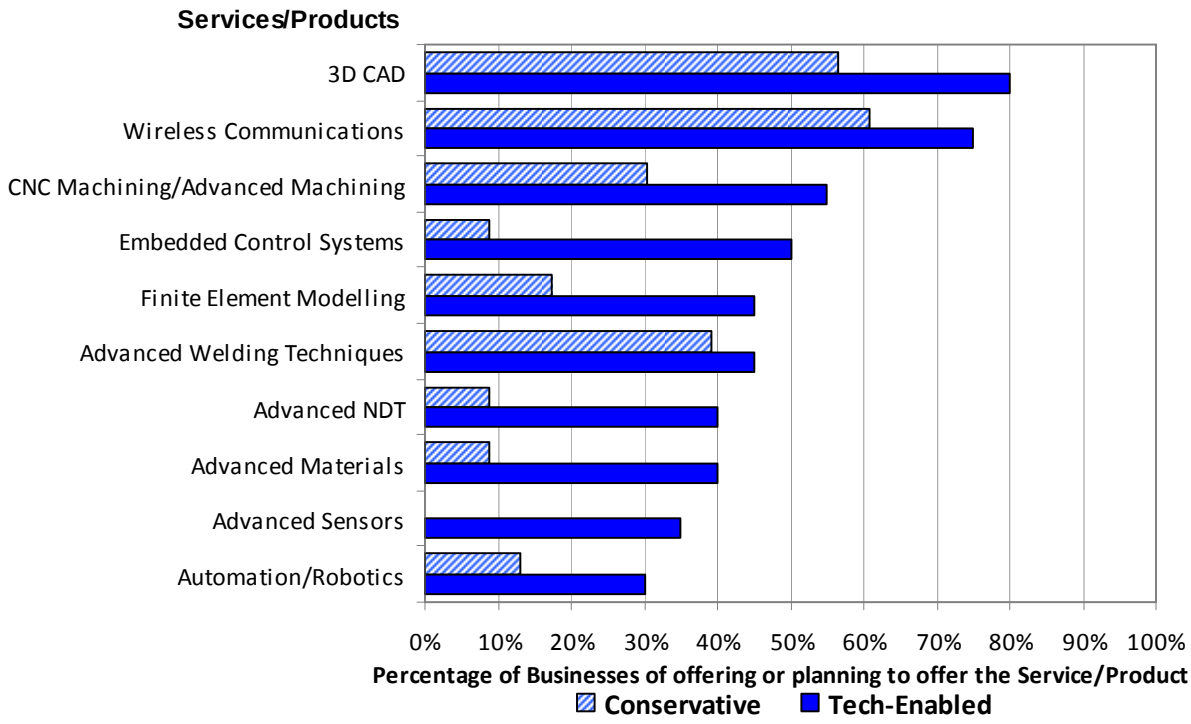


Figure 8: Adoption of New and Emerging Technologies by Tech-enabled and Conservative Companies

As discussed further in **Section 4**, the different level of engagement with new and emerging technologies influences the perceptions and concerns relating to skill gaps for those businesses.

3.5 Research Activities of Manufacturing and Engineering SMEs

Of the companies who responded to the Hunter Skills Survey, 50% were involved in research activities of some type, however the Tech-enabled companies were more likely to be involved in research activities than the Conservative companies. The responses to questions relating to research activities are shown in **Figure 9**.

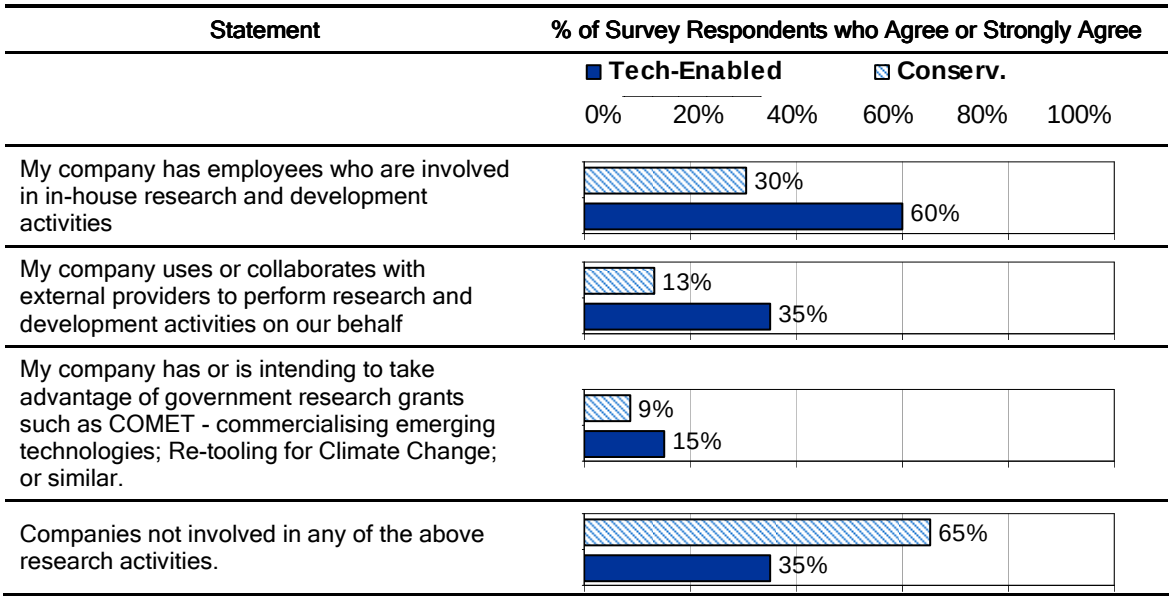


Figure 9: Research and Development Activities by Tech-enabled and Conservative Companies

Figure 9 indicates that while Conservative companies are significantly less involved in research activities than Tech-enabled companies, a sizeable proportion of the Conservative companies (30%) do perform in house research and development.

Only five companies surveyed (12% of all businesses surveyed) had taken, or are intending to take advantage of government research grants.

4. EMERGING SKILL SETS

A primary focus for this project was to identify those skill sets arising from **technological changes** that were perceived by employers to be important for their future competitiveness. The emerging skill sets, either by nature of the specific skill, or by the combination of skills required in the skill set, can be considered a skill gap. The definitions of skill gaps and skill shortages are as follows:

> **Skill Gaps –** occur when employers consider the available labour pool and or their workers to be underskilled relative to some desired level. Skill gaps often occur when new technologies or processes are introduced into an industry and there is a misalignment between training focus and skill needs.
>
> **Skill Shortages** - occur when the demand for workers in a particular occupation is greater than the supply.

Of the all business responding to the survey, 75% had experienced skill gaps in the last twelve months. The skill gaps were experienced in both Tech-enabled and Conservative companies, as shown in **Figure 10**.

Statement:	Skill gaps in my workforce (inadequate levels of skills in the labour pool) have been an issue for my company in the last twelve months.

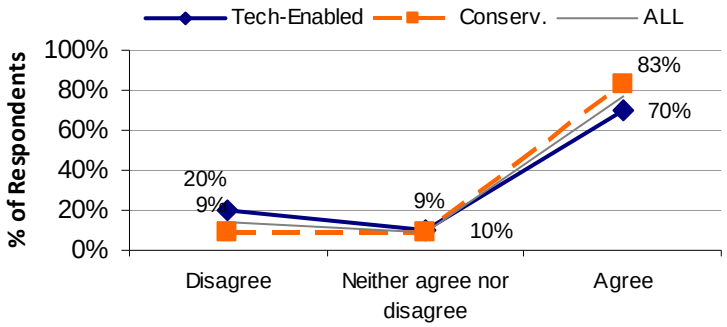


Figure 10: Survey Results – Skills Gaps

During focus groups sessions, many participants described instances where technologies had been introduced, but had not been successfully implemented. For example, technologies that were not used, the workforce had not been trained, the technology was found to be unsuitable, or the technology was not able to be adequately maintained. For some businesses it was quite difficult to pinpoint what the expectations for skills would be:

> *"We are not sure what the skills are going to look like."*

The focus group sessions and subsequent survey revealed that skills gaps associated with technological changes arise both directly and indirectly, and are not strictly about specific high-tech equipment and specific skills. The emerging skill sets that are directly attributable to new and emerging technologies include those skills necessary to operate and control specific technologies. The emerging skill sets that are indirectly attributable to technological change are those relating to the skills required to manage the increased complexity and changing customer requirements that have developed with increasing use of the technology.

The main themes with respect to the emergence of skill sets are the requirements for:

- Core Skills – applicable to a particular trade or degree qualification;
- Converging Skills – skills that cross-over the traditional skill sets for an occupation, for example, fitters who are able to perform basic electrical work, joiners who are able to weld;
- Enabling Skills - generic skills that allow a business to be more responsive to customer requirements. These skills include "lean manufacturing" and "competitive manufacturing", as well as project management, and internet skills.
- Business Skills - skills to support business growth; and
- Environmental Management Skills – skills relating to sustainability and related topics.

The following section examines the emerging skill sets based on these themes.

4.1 Core Skills

Core skills describe the key sets of competencies required by a worker for their specific field. These include the practical skills that are required to competently apply knowledge in the area of expertise, and the skills required to perform the specific tasks of the occupation.

From the focus groups, there was a perception expressed that increasing complexity and specialisation had lead to a lack of focus on core skills. For example:

- Engineers who are perceived as lacking practical know-how related to manufacturing (Can it be made cost effectively, can the material be sourced, are our machines capable?);
- Newer employees lacking skills in practical business skills – for example, costing jobs; and
- Concerns with the skill-levels of some of the fast-tracked apprenticeships.

> *"Two years of industry experience – expected to be on $65K. They do not have the experience. You can not get it in two years."*

Across all of the occupations surveyed, trades-based, paraprofessionals and engineering, employers expressed dissatisfaction with the practical skills associated with those occupations.

> *"Impractical – can't be built. Very good draftsmen - but no idea of how things are actually fabricated."*
>
> *"Newly trained CAD operators are generally very poor at drafting practical solutions that are able to be manufactured. They should be trained up with more knowledge of what is required to actually build something. They (and possibly their training) are focused on drawing nice drawings as opposed to something that is practical and efficient to build."*

The same sentiments were expressed of employees involved in fabrication operations:

> *"Still need a lot of knowledge of how to fabricate … even though the computer is doing everything – still need the practical knowledge."*

For engineers:

> *"ALL engineers should be made to do 3 years in the field so they can put their university training to practical use."*
>
> *"Engineers need on the job experience (hands on)."*
>
> *"Need to focus on prime core skills - people with passion for specialist engineering will evolve with correct attitude on top of good base skills set."*

This perceived lack of core skills for the trades-based employees was assessed in the survey using the question: ***"My recently qualified trade employees have a good understanding of the core skills for that trade".*** For engineers, and the designers, the survey focussed on their practical skills. The survey results are shown in **Figure 11**, **Figure 12** and **Figure 13**.

Statement: My recently qualified trade employees have a good understanding of the core skills for that trade.

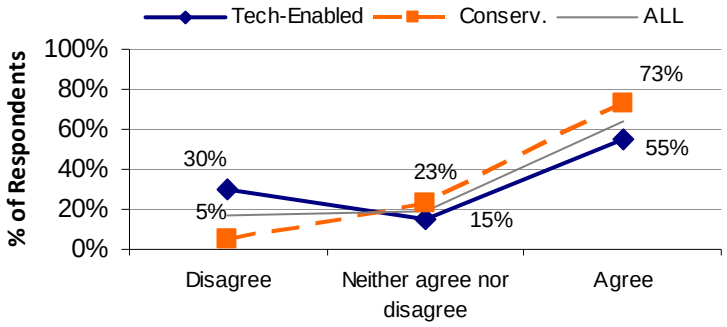


Figure 11: Survey Results – Trade-based Employee Core Skills

The survey results, as shown in **Figure 11**, indicates that a clear majority of businesses surveyed are generally satisfied with the core skills of their trade-based employees. Significantly, nearly a third of the Tech-enabled companies **disagreed** that the trade employees have a good understanding of the core skills. It is quite possible that Tech-enabled companies have a different expectation of what the core skills for a tradesperson should be.

Statement: The currently available engineering courses develop pragmatic engineers (able to implement practical engineering solutions).

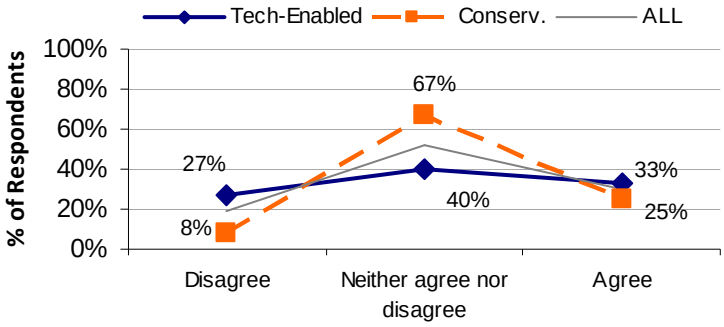


Figure 12: Survey Results – Graduate Engineers – Practical Skills

In terms of the practical skills of engineers, there was no clear consensus on the ability of these engineers to develop pragmatic solutions. The majority of respondents were non-committal about the practical skills of engineers, with the remainder of businesses taking opposite views. Focus group participants reported some difficulties with recent graduates applying sound engineering theory, but applying impractical use of raw materials or components. The proportion of Tech-enabled businesses who **disagreed** that graduate engineers possess practical skills is close to 30%.

Statement: The currently available design courses develop pragmatic design skills (i.e. able to produce fit for purpose designs).

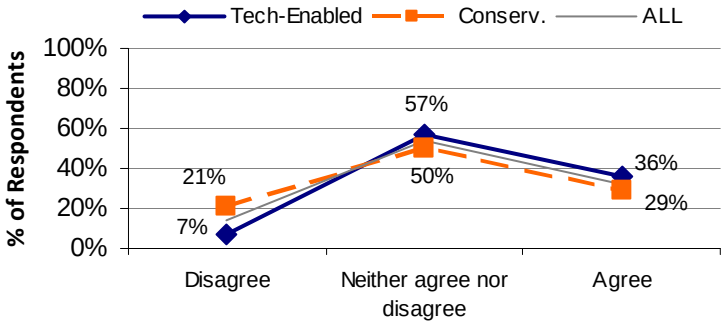


Figure 13: Survey Results – Designers – Practical Skills

Similarly, there was no clear consensus on the ability of designers to develop pragmatic solutions, with significant proportions of survey respondents both agreeing and disagreeing that the currently available design courses develop pragmatic design skills.

4.1.1 Technology specific skills

In addition to the core and pragmatic skills required, skills specific to emerging technologies were identified during focus groups, and from the survey. These specific skills, as described by participants in the focus groups and the survey, are shown in **Table 3**.

Table 3: Skills Requirements for Specific Emerging Technologies

New / Emerging Technology	Skill Requirements
Robotic Welding	- "Someone to control the robot" - "Robotics in welding ... Not sure where to find someone who would have the skills to control the robot."
Advanced Welding	- "Latest welding procedures on the latest high grade steel."
Non-destructive testing	- "Tribology is a huge emerging technology – there is not one mining company who is not performing tribology in their mines."
New technology in general…	- "Who is going to drive these machines? Where do they get those skills?"
Embedded Software	- "Manufacturing needs to move into the smarter areas. Embedding software in products to provide competitiveness. It can't be copied."
Hydraulics and Pneumatics	- "Skill sets required for our business are advanced hydraulics and pneumatics." - "More emphasis on fluid power engineering - develop specialist electives would help."
3D CAD	- "The gaps for us include ability to program CNC equipment and ability to do 3D modelling." - "Practical application of modelling and design to business requirements." - "Improved ability to transfer concepts into practical plans/products/services." - "Skills to manage the interface between a CAD drawing and the machine that performs the work."
CNC Machining	- "CNC Programming – expectation that machine operators will also be able to program the CNC Machines." - "Understand how to read and interpret 2D and 3D CAD drawings."

4.2 Converging Skills

Converging Skills describe those skills that cross the boundaries of traditional trade-based skilling. The most common driver for converging skills sets was related to the increasing use of electronic components in products, processes and services. Requirements for converging skill sets were also expressed by businesses that, for example, were using joiners for welding, electricians performing mechanical tasks, CNC operators performing programming.

There was a general agreement expressed in the focus group sessions that electrical components are making their way into a range of equipment types. For some businesses, the integration of the electronic components into their processes, or products they are servicing, can present difficulties. This is particularly true with respect to PLC's (programmable logic controllers), and components sourced from overseas:

> *"Customers get all this technology – then they ring up one day and want it fixed. All the investment seems to be put into developing the technology. But then the people are not being bought in behind who know how to fix it."*
>
> *"Machines sitting idle because no-one knows how it's fixed."*

The challenge for businesses that are using electrotechnology-based technologies is access to people with a good applied knowledge of control systems, communications and electronics, and who are interested in working in manufacturing and engineering SMEs. Based on the focus group discussions, some businesses are struggling to attract people who both understand the electrotechnology and who are willing to apply that knowledge in a workshop-environment.

The risks to those businesses focussed on traditional technologies that are employing technologies for the first time is in being left "high and dry" when the technology doesn't perform as expected or breaks down.

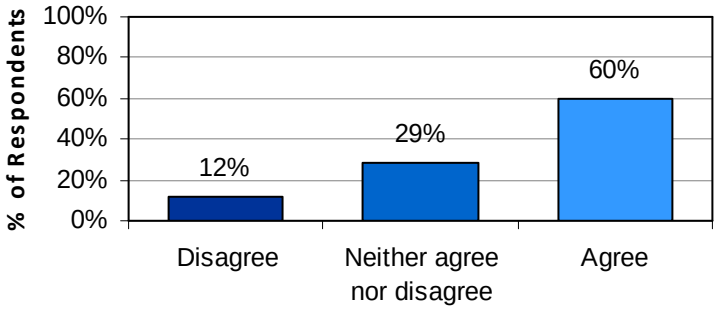
> *"Big concern is that you find yourself dependent on someone else who doesn't know how to service it."*

From the focus group discussions, the need for traditional metal trades and fitting and turning trades to incorporate some elements of electronics was expressed on a number of occasions:

> *"The skills that we need: Basic kind of things. There are now a lot of electronics. We need fitters who are trained for the electrical side of the things. Electricians who are more mechanically-minded."*

This requirements for a convergence of skills was reiterated during the survey, in the question, "***Emerging technologies (e.g. integration of electronic components, automation, CNC etc.) has created a need for more cross-functional skills in my trade-qualified employees***". The responses to this question are shown in **Figure 14**.

Statement: Emerging technologies (e.g. integration of electronic components, automation, CNC etc.) has created a need for more cross-functional skills in my trade-qualified employees.



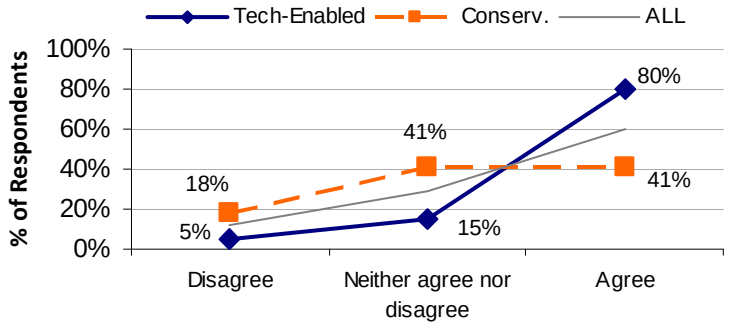


Figure 14: Survey Results – Convergence of Skills

The results from the survey, as shown in **Figure 14** indicate that the majority (60%) of all businesses responding to the survey perceive that more cross-functional skilling of trade employees is required. For businesses that are Tech-enabled, the proportion agreeing that there is a need for more cross-functional skills in trade-based employees rises to 80%.

For businesses that are supplying products which include electronic components, the ability to provide support and/or training relating for the product is also important.

> *"We installed a PLC into what otherwise was a fairly standard mechanical item. The PLC was able to perform self-diagnosis, and provide real-time and historical data to the operators. But the training requirements were higher, and there was no-one able to diagnose the PLC, so the product was shelved."*

Some businesses have recognised that the ability to provide the backup service and support for products had created new market opportunities.

> *"If you are supplying sophisticated equipment, being able to service it is a must. It's difficult because customers try to pinch your staff."*

4.3 Enabling Skills

Enabling Skills describe the generic skills that allow a business to be more responsive to customer requirements. These skills include "lean manufacturing" and "competitive manufacturing", as well as project management, and general business skills.

With respect to the use of new and emerging technologies, "enabling" skills allow a business to leverage the use of technology for competitive advantage.

> *"A lot of onboard diagnostics - we use that as a strong differentiator. We have a team of technicians who support it."*

4.3.1 Skills related to competitive manufacturing

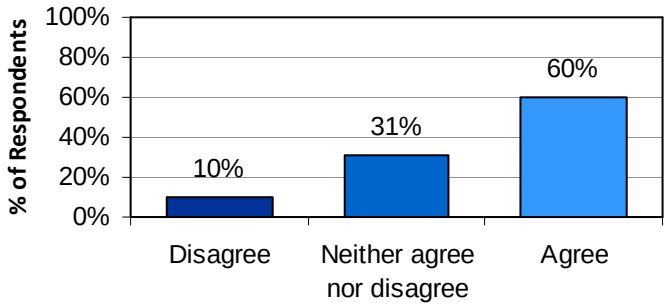
When prompted about the new and emerging technologies that their business was using, a number of businesses provided "lean manufacturing" and "competitive manufacturing" in answer. While strictly speaking not a "technology", the skills associated with these approaches ***enable*** the use of technology.

With computer-based control systems, and increasing data-storage potential, manufacturers are "closing the loop" to be able to collect, retrieve and analyse data about their production processes, their products, and their services. The ability to use this data is changing manufacturers' understandings of the base costs, and increasing the push towards lean manufacturing.

Currently TAFE does offer training programs in the area of competitive manufacturing that are able to be delivered in a reasonably flexible format. From the focus group sessions, it was apparent that employers felt that some of these skills and competencies associated with competitive manufacture should be incorporated into the traditional trade programs.

The requirement for skills relating to "competitive manufacturing" was assessed in the survey question, "***I would like my trade based employees to have a greater understanding of 'competitive manufacturing" (e.g. lean manufacturing, six sigma etc.)***". The results from the survey, as shown in **Figure 15**, indicate that the majority (60%) of all businesses responding to the survey would like their trade-based employees to have an improved understanding of the concepts relating to competitive manufacturing. For businesses that are Tech-enabled, this proportion rises to 75%.

Statement:	I would like my trade based employees to have a greater understanding of 'competitive manufacturing' (e.g. lean manufacturing, six sigma etc.).



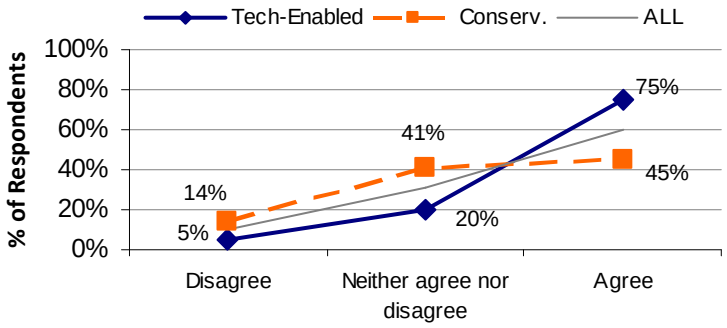


Figure 15: Survey Results – Competitive Manufacturing

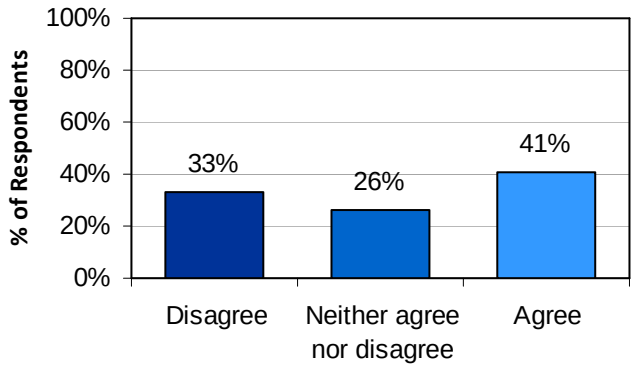
4.3.2 Project management and production control skills

Project management was an area in which companies expressed difficulty in finding people with the right skill sets. Project management skills refer to those skills required in defining project objectives and deliverables, managing resources, and meeting project objectives. Comments made during the focus groups suggested that project managers are often recruited from bigger industries, particularly defence, and were not coming from the traditional TAFE and university learning pathways.

As discussed in **Section 3.2.1**, some of the increased need for project management skills is a result of an increasing customer requirement for project management services. Another important driver for the need for project management skills is the increasing complexity of manufacturing.

The current skill level of engineers with respect to project management was assessed in the question, "***University graduates have a sufficient level of understanding of project management concepts***". The results from this question are shown in **Figure 16.**

Statement: University graduates have a sufficient level of understanding of project management concepts.



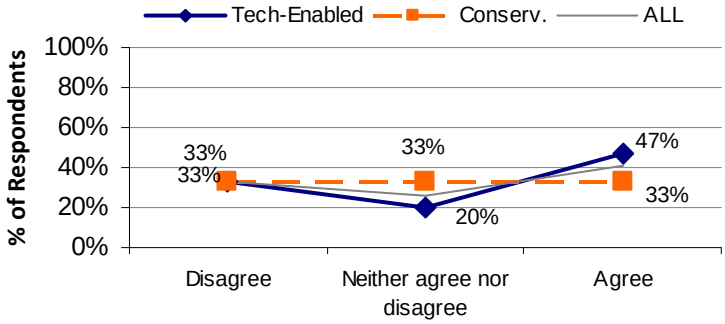


Figure 16: Survey Results – Project Management Skills

While a significant proportion, one-third of all businesses, disagreed that university graduates have a sufficient understanding of project management concepts, an equal number agreed that the level of understanding was sufficient.

4.3.3 Production management skills

In terms of production control, businesses identified that production control skills were needed both for the people who were performing a scheduling role, and also for the engineering and production teams:

> *"It's not enough for a student to come out of uni being able to make a whiz-bang widget. I need him to be able to make one hundred widgets in a week."*

The requirements for improved production skills arise for a number of reasons, including increased efficiencies, being able to meet customer requirements, and maximising the productivity of expensive equipment.

4.3.4 Skills relating to the use of internet communications

The use of the internet has changed the way that many businesses are communicating with their customers. The adoption of technologies relating to the use of the internet was described in **Section 3.2.2.** From the survey, over half of the businesses surveyed were employing e-business and internet communications in their companies. This result is supported by the responses to the survey question that asked participants their view on the internet changing the way business communicates with customers, as shown in **Figure 17**.

Statement: Emerging technologies relating to communication, the internet and e-business has changed or is expected to change the way my business communicates with current and potential customers.

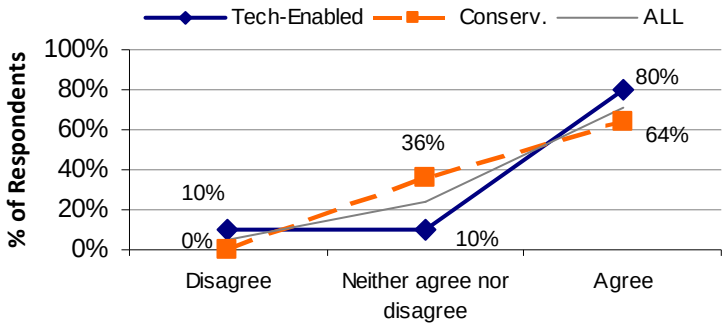


Figure 17: Survey Results – Internet and Communication

The clear majority of companies perceive that the internet is changing the ways in which they communicate with customers, but again it is clearly more significant for the Tech-enabled than the Conservative companies. The effect of the internet and e-business on the skills requirements of businesses was also surveyed, as shown in **Figure 18.**

Statement: Emerging technologies relating to communication, the internet and e-business will change the skills required by my employees to service customers and grow my business.

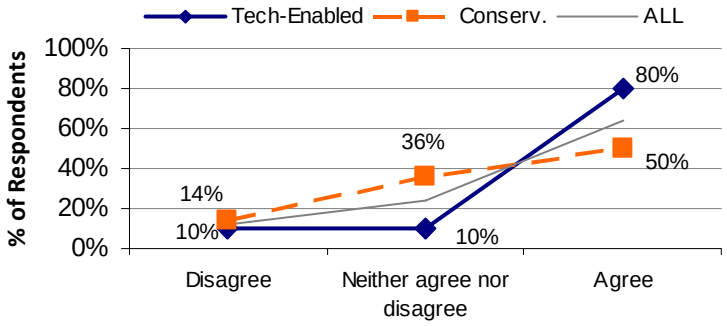


Figure 18: Survey Results – Internet and Skills Required

Figure 18 strongly re-iterates that changes in the ways in which business communicates with customers, resulting from e-business and internet technologies, is also expected to change the skills required by employees.

4.4 Business Skills

For all businesses that participated in the survey, the responses to questions regarding the business understanding of their trade based and engineering employees was unanimous: the perception is that both trade-based and university trained engineers have insufficient understanding of business operations. The relevant questions and responses are shown in **Figure 19**.

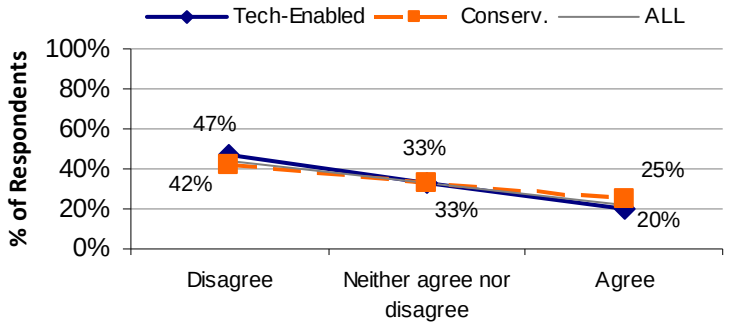
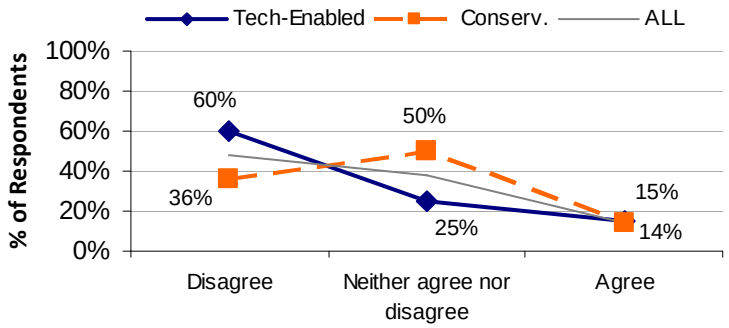
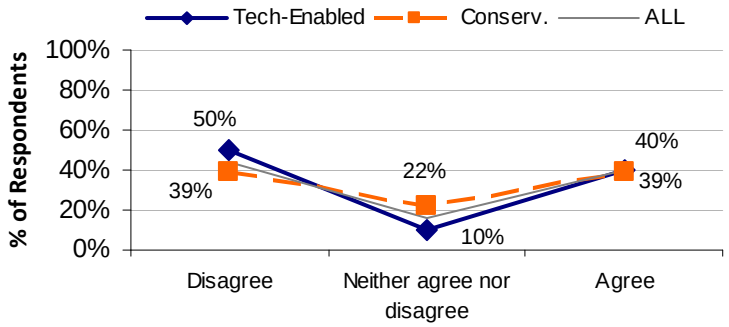
Statement:	Response:
University graduates have a sufficient level of awareness of business operations.	
My recently qualified trade employees have a sufficient understanding of business operations.	
My workforce has the required level of business development skills (communication customer awareness service product knowledge market awareness) to meet the businesses' needs now and for the next 5-10 years.	

Figure 19: Survey Results – Satisfaction with Business Understanding

The responses to the question regarding business development skills indicate a polarised view of whether or not the required levels of skills exist.

The large number of people responding in the negative to the questions regarding business understanding and business development skills indicates that a need exists to develop these business skills.

While many businesses indicated that the business skills of newly qualified trade and engineering staff were not sufficient for their requirements, the majority of businesses also indicated that they were aware of training that is available to develop business skills, as shown in **Figure 20.**

Statement: I am aware of training that can be provided to my employees to develop their business building skills.

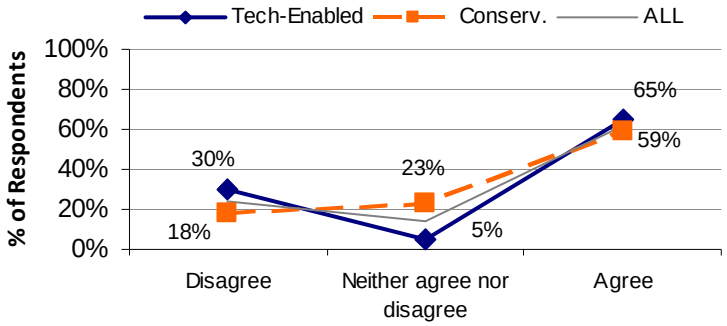


Figure 20: Survey Results – Awareness of Training Relating to Business Building Skills

4.5 Skills Relating to Sustainability

With increasing energy costs, increasing consumer awareness and community concerns, issues relating to sustainability are becoming more important to businesses, small and large alike.

For some of the businesses that participated in the focus groups, issues relating to sustainability were not considered to be an issue beyond compliance. For those businesses, the perception of sustainability and environmental issues were likened to perceptions of OH&S and quality systems: systems were cumbersome, and compliance was the main issue. For other businesses, "green markets" were seen to be opening up new opportunities for products and services. From the survey results, the difference in perceptions relating to sustainability issues between the Tech-enabled and Conservative companies provide a strong contrast.

From the survey, there was a strong consensus by all businesses that skills relating to energy management will become more important in the next ten years. The response to the survey question relating to energy management is shown in **Figure 21**.

Statement: In the next ten years skills relating to energy management will become more important to my business.

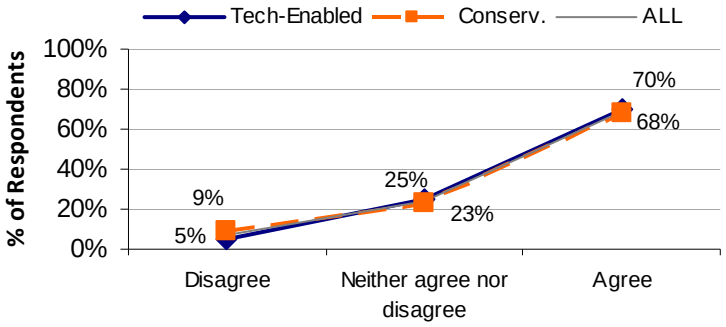


Figure 21: Survey Results - Energy Management

The perception of new market opportunities arising from sustainability related issues was assessed in the survey with the question, "***Issues relating to sustainability will potentially provide new market opportunities for my company***". Overall, 60% of the companies surveyed agreed with this statement. There was a clear difference in responses to this question by the Tech-enabled and the Conservative companies, as illustrated in **Figure 22**. 75% of Tech-enabled companies perceived there would be new market opportunities, while 50% of Conservative companies held the same view.

Statement: Issues relating to sustainability will potentially provide new market opportunities for my company.

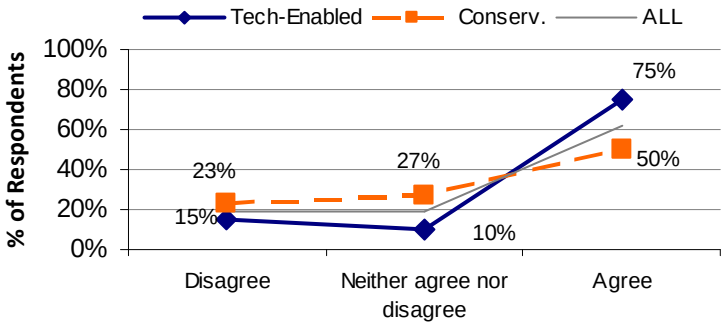


Figure 22: Survey Results - Market Opportunities arising from Sustainability

The polarity in the opinions of the Conservative and Tech-enabled business is also demonstrated by the responses of the survey question "***My company is pursuing 'Green Options' to meet customer and/or community expectations***", as shown in **Figure 23**. The survey responses indicate that **six times** as many Tech-enabled companies as Conservative companies are considering green options.

Statement: My company is pursuing "Green" options to meet customer and/or community expectations.

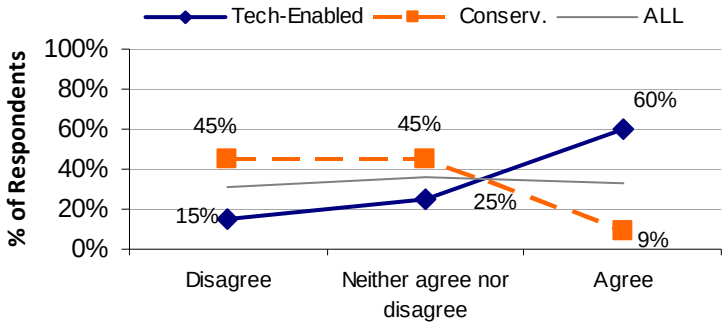


Figure 23: Survey Results – Green Options

5. PERCEPTIONS OF TRAINING PROVIDERS IN THE HUNTER REGION

The Hunter Manufacturing and Engineering Skills Project aimed to understand the effects of emerging technologies on the skill requirements of small and medium businesses in the Hunter Region. The existing perceptions of those businesses towards the main providers of training for trade-based, para-professional, and graduate engineers are important in developing strategies for the provisions of those skills.

The analysis of data collected during the skills survey identified that an organisation's perception of training providers was heavily influenced by their engagement with technology. Tech-enabled and Conservative companies had vastly different perceptions of both the TAFE and university training providers.

5.1 Employer Perceptions of TAFE Provided Training

In the 2008 report **World Class Skills for World Class Industries,** by the Australian Industry Group[4], it was suggested that global trends in business in general has implications for future skill requirements in three ways:

1. A higher level of skill being required.
2. Skills will need to be updated more often than they have in the past.
3. A broader range of skills will be required.

In this research project, the ability for TAFE to meet these skill requirements was assessed by asking a series of questions relating to the training courses offered by TAFE for trade-based employees. The questions and responses of survey participants are shown in the following tables.

[4] Australian Industry Group, ***World Class Skills for World Class Industries***, May 2006.

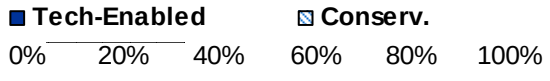
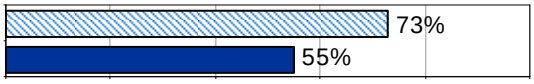
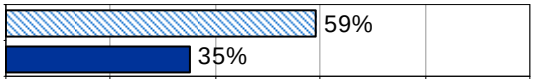
Statement	% of Survey Respondents who Agree or Strongly Agree
	
The traditional training qualifications will meet the majority of my trade-based skill requirements for the next 5 – 10 years.	
My recently qualified trade employees have a good understanding of the core skills for that trade.	
In general, recently qualified trade employees understand the latest technologies applicable in their field.	
TAFE training facilities reflect the current manufacturing capability of my business.	
My recently qualified trade employees have a sufficient understanding of business operations.	

Figure 24: Survey Responses – Perceptions of TAFE Provided Training

In general, the responses to survey questions shown in **Figure 24** indicate that Conservative companies are on the whole satisfied with the training provided by TAFE. The responses by the Tech-enabled companies are quite different however. While the majority of these companies indicate that the traditional training qualifications will meet their needs in the near future, only just over half of these companies believe that recently trade qualified employees have a good understanding of core skills.

In terms of the technology, only one in five of the Tech-enabled companies agree that TAFE training facilities reflect the current manufacturing capability of their business. Similarly, only a small proportion of respondents from Tech-enabled companies agreed that recently employed trade employees understand the latest technologies in their field.

The implication of these results is that TAFE is doing an adequate job of providing skills and training to the Conservative companies – those companies who, by their own assessment, are not employing new and emerging technologies.

In contrast, for Tech-enabled companies - those companies who are embracing new and emerging technologies – the survey results suggest that the training facilities are not keeping up with the technologies, and that trainees are not being exposed to the latest technologies.

Survey questions relating to the perceived changing skill requirements for trade-based employees are shown in **Figure 25**. The responses to the survey question by Tech-enabled and Conservative companies again demonstrate the significant differences in perceptions between these two groups.

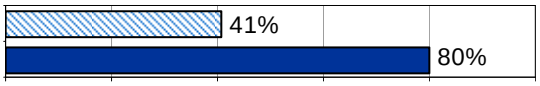
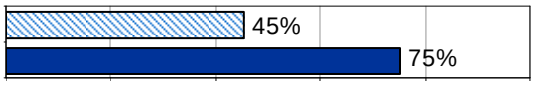
Statement	% of Survey Respondents who Agree or Strongly Agree
	Tech-Enabled / Conserv.
Emerging technologies (e.g. integration of electronic components automation CNC etc.) has created a need for more cross-functional skills in my trade-qualified employees.	
I would like my trade-based employees to have a greater understanding of 'competitive manufacturing' (e.g. lean manufacturing, six sigma etc.).	

Figure 25: Survey Responses – Changing Requirements for the Skills of Trade-based Employees

The attitudes of Tech-enabled and Conservative companies towards collaboration with TAFE are relatively similar, as demonstrated in **Figure 26**. Approximately 60% of businesses are aware of the training programs offered by TAFE to up-skill employees, while just under half of the businesses surveyed would be willing to let training providers deliver training in their workplace. Almost half of the businesses surveyed would consider approaching TAFE to improve their understanding of emerging technologies.

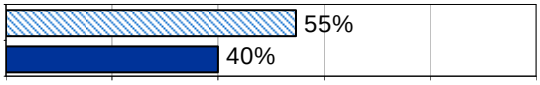
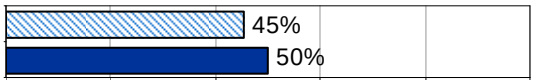
Statement	% of Survey Respondents who Agree or Strongly Agree
	Tech-Enabled / Conserv.
I would be willing to let training providers deliver training to my staff in my workplace using my facilities.	
I am aware of training programs offered by TAFE to upskill my employees.	
I would consider approaching TAFE to improve my understanding of emerging technologies.	

Figure 26: Survey Responses – Attitudes towards Collaboration with TAFE

5.2 Employer Perceptions of University-Based Training

60% of the businesses surveyed employ one or more university trained engineers. Engineers were employed in both the Tech-enabled and Conservative businesses, and in businesses involved in all industry sectors.

In general, the majority of employers are satisfied with the skill levels of university graduates, with nearly 75% of businesses agreeing that the current skill sets of graduates will meet their business needs for the next 5 to 10 years.

A large difference in the perception of the skills of university trained engineers was identified between the Tech-enabled and Conservative businesses. The most significant difference is in the perception of the ability of current engineering courses to develop innovative engineers. 80% of Tech-enabled businesses perceive that their engineering graduates understood the latest technologies applicable in their field, and nearly 70% of these businesses believed that the current engineering courses develop innovative engineers. This is in contrast to Conservative businesses, of which only 17% perceive that the engineers are able to generate innovative solutions.

The difference in the perception of innovation in engineering graduates between the two types of business may be due to the ability of Tech-enabled companies who, having already adopted emerging technologies, are able to attract and recruit the more innovative candidates.

Clear areas for improvement in training relate to the practical skills of engineering graduates, and their awareness of business operations.

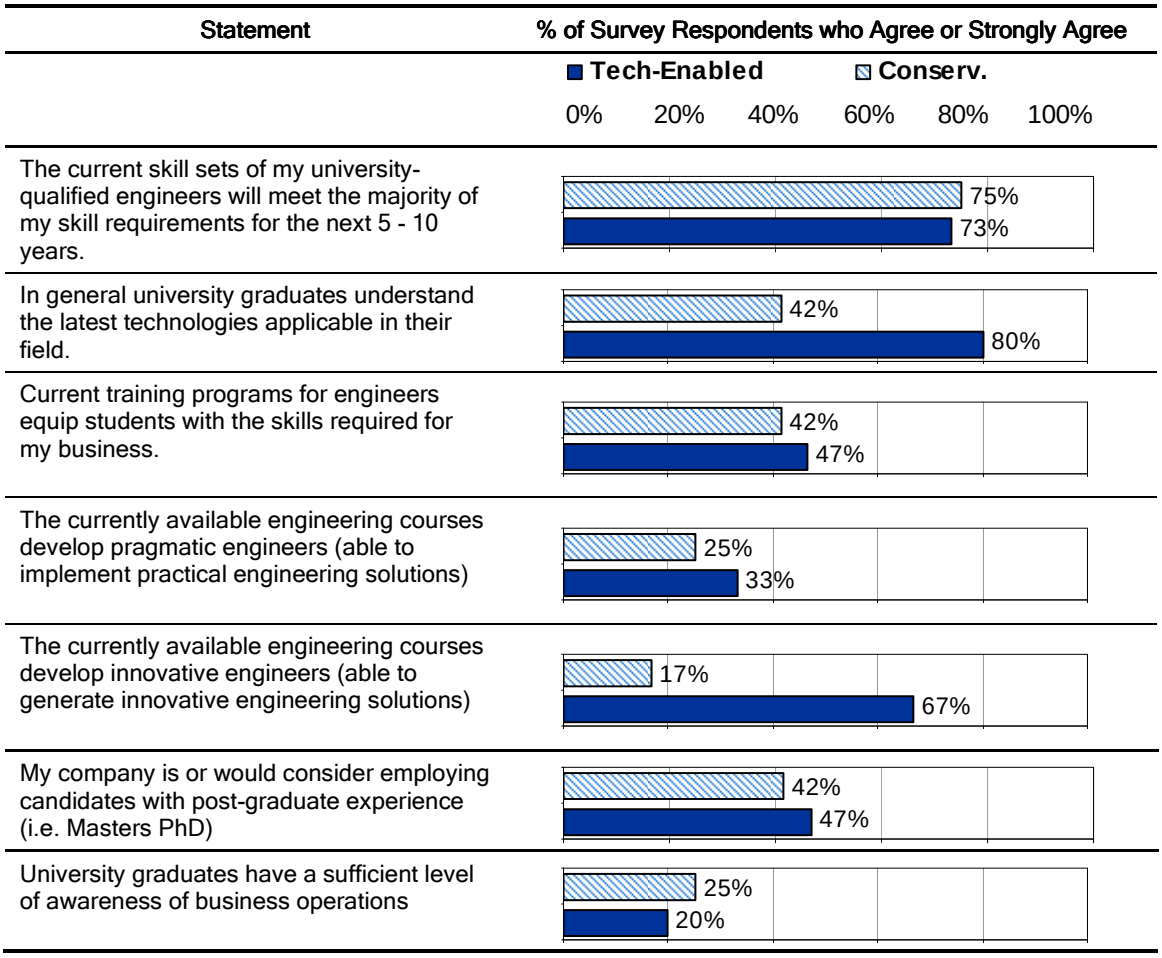


Figure 27: Survey Responses – Perceptions of University Provided Training

The attitudes of Tech-enabled and Conservative companies towards collaboration with the university are quite different, as demonstrated in **Figure 28**. Twice as many Tech-enabled companies are aware of training programs to up-skill employees when compared to the Conservative companies. Similarly, Tech-enabled businesses are twice as likely as Conservative businesses to consider approaching the university to improve their understanding of emerging technologies.

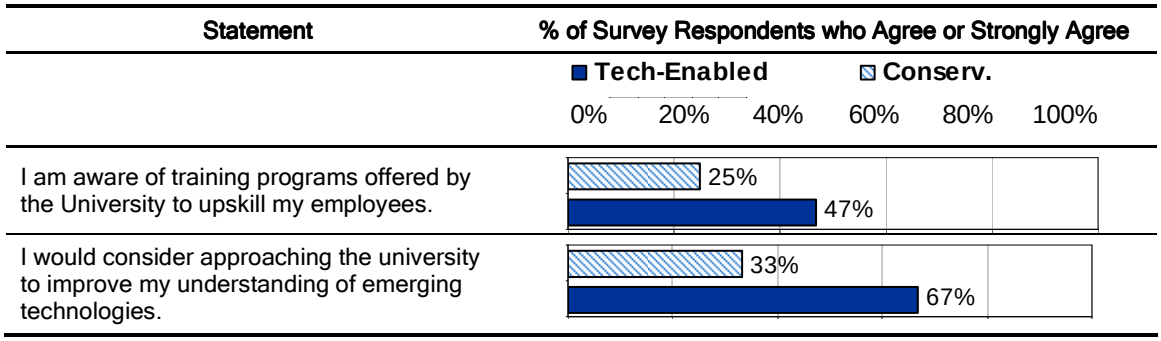


Figure 28: Survey Responses – Attitude Towards Collaboration with the University

From **Figure 26 and Figure 28,** Tech-enabled companies are more likely to approach the university than to approach TAFE to improve their understanding of emerging technologies. Conservative companies are more likely to approach TAFE than the university.

5.3 Employer perceptions of Training for Para-Professionals

70% of the businesses surveyed employ one or more para-professionals. The survey responses indicated that while the skills required to operate drawing packages and related technologies were adequate, the practical and innovative skills of these designers were not as highly regarded. The responses to the survey questions are shown in **Figure 29**.

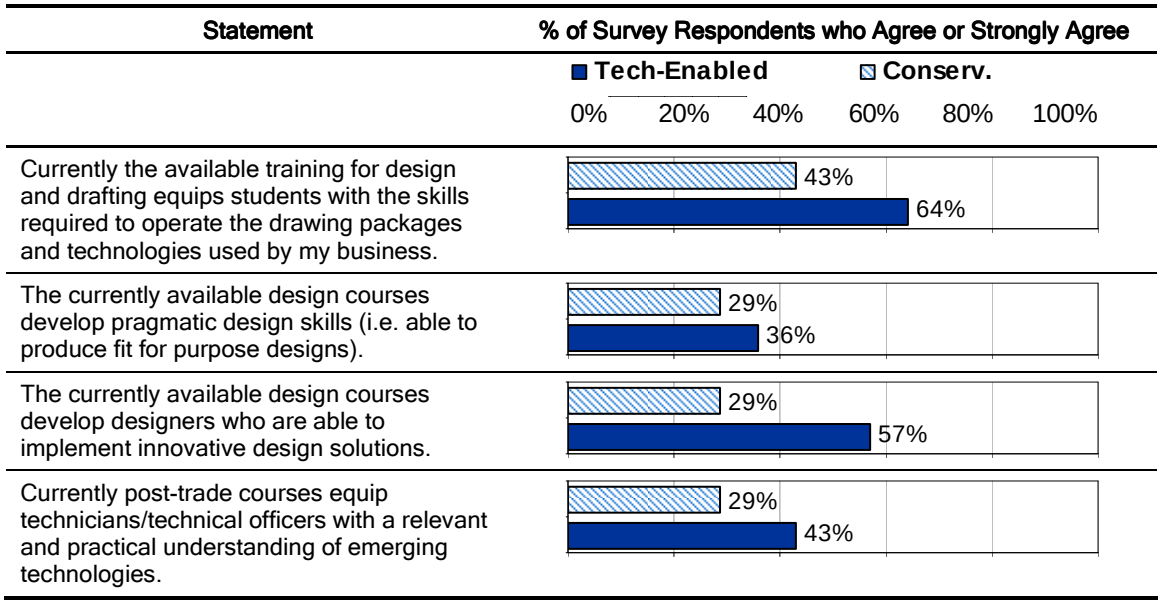


Figure 29: Survey Responses – Perceptions of Para-Professional Training

There was a significant difference in opinion of the ability of design courses to develop innovative designers between the Tech-enabled and Conservative companies. As for engineers, the difference in perception of innovativeness may be due to the ability of Tech-enabled companies to attract and recruit the more innovative candidates, or that there may be more opportunity for designers to develop innovative solutions in the Tech-enabled companies.

6. DISCUSSION

New and emerging technologies are being adopted by the majority of Hunter Region manufacturing and engineering businesses. For most businesses, customer requirements are becoming more sophisticated and driving the adoption of new and emerging technologies. For all businesses surveyed:

- The incorporation of electronic components into a range of products is driving the need for cross-functional and electrotechnology skills;
- Business skills for trades-based, professional and para-professional employees was an issue for all employers; and
- For recently trained engineering and para-professional staff, employers were not satisfied with the level of practical skills.

There is a significant difference in perceptions between the companies described as Tech-enabled, and those described as Conservative in this report. In meeting the skill requirements of emerging technologies, the different perceptions and requirements for these two groups need to be recognised.

In general, Tech-enabled companies do not perceive trades-based training as reflecting their manufacturing capability. Similarly they do not see TAFE as producing tradespeople who understand the latest technologies. For their trade-based employees, these businesses are requesting skills related to competitive manufacture, and for increased levels of multi-skilling.

To meet the skill requirements of the trade-based employees of Tech-enabled companies, training providers need to ensure that training facilities provide a better opportunity for trainees to use and understand the latest technologies in their field. While these technologies may be expensive, options for leasing equipment, entering into agreements with suppliers, using ex-demo equipment or sharing equipment across a range of NSW TAFE institutions should be investigated. Another option is to forge stronger relationships between the training providers and companies who are using the technologies. For example, some employers may be willing to make their equipment available for training purposes to training providers, when not being used for production.

Opinions stated by participants in focus groups, and in the survey, was that a stronger relationship between TAFE and employers is required. Options for improved communications and knowledge sharing between employers and TAFE should be further investigated. These options may include opportunities for businesses to host TAFE students as part of work placements in support of training, or practical demonstrations of equipment and process technologies to TAFE students by willing businesses.

The disparity between the Tech-enabled companies and the Conservative companies who participated in this project was striking. While the Tech-enabled companies were expressing well-informed views of emerging technologies, explaining how technology was being used to meet the changing needs of customers, and describing high levels of innovation amongst their employees, Conservative companies were almost the opposite. The Conservative companies, who described themselves as not employing emerging technologies, were generally not aware of emerging technologies, and described low levels of innovation in their designers and engineers.

For Conservative companies, strategies that support these companies in their adoption of technology are required. Essentially, those Conservative companies would benefit from a “technology mentoring” scheme, if one existed. The strategies would include providing assistance to those businesses to

identify which technologies would be applicable to their businesses, and providing assistance in successfully introducing these technologies.

> *"Find out where you can go to find out.... One of the challenges is finding out what is out there. Staggering around in the fog."*

The Hunter Region's manufacturing network, HunterNet, and the Australian Industry Group (AiGroup) are two organisations that may be able to provide benefit to Conservative companies, by providing support and information to businesses on new and emerging technologies and in their adoption of technology.

Many of the skills arising from emerging technologies, and the related changes in manufacturing complexity may require complementary training in addition to the core skills. The skills referred to in this report as "enabling skills", such as business skills, production scheduling, and product costing, are relevant to both the trade and university qualified workforce. As such, co-operation and linkages between training providers may provide improved pathways to deliver the required skill training to a broad cross-section of the workforce.

It is recognised that a number of constraints exist in the provision of skills training. These constraints include that core competencies are not compromised as a result of additional training requirements. In most cases, the skill requirements identified in this report may be able to be provided as supplementary training modules. However, for technologies that are approaching maturity, the results of this project suggest that the skills that constitute "core competencies" may be shifting, particularly for trade-based employees.

7. CONCLUSION AND RECOMMENDATIONS

The Hunter Manufacturing and Engineering Skills project showed that a number of technologies, at different stages of maturity, have been recently adopted by Hunter Region SMEs, and are expected to continue to be important in the future. These include the relatively mature technologies of three-dimensional computer-aided design (3D CAD) and computer numerically controlled machining (CNC), and the emerging technologies relating to sensors, embedded control systems and automation.

One of the key findings of the report was that the perception of new and emerging technologies by a business translates directly into perceptions of skill requirements, satisfaction with training courses, understanding of customer requirements and engagement in sustainability. Based on responses to the survey, two groups of companies were identified: "Tech-enabled" companies, and "Conservative" companies.

The survey showed that companies who are "Tech-enabled" are more aware of emerging technologies and are more satisfied with their engineering staff, particularly in terms of their level of innovation and understanding of technology. Tech-enabled companies are more aware of changing customer requirements, and more likely to be providing an extended range of products and services. These companies identified converging skills, and the skills associated with competitive and lean manufacturing as being important to their business in the future. Tech-enabled businesses indicated that training for their trade-based staff did not reflect their current capabilities, or produce tradespeople who were aware of the latest technologies.

The group of companies described as Conservative in this report do not perceive themselves as employing new and emerging technologies, although all but one had employed at least one of the technologies identified in this paper. In general, Conservative companies do not consider the technologies that they are using "high tech". They are satisfied with the skills of recently qualified tradespeople and expect the skills possessed by these tradespeople to meet their trades-based skilling requirements for the next 5-10 years. They are less satisfied with the skill-levels of university graduates than the Tech-enabled companies.

Regardless of the level of adoption of technology, all businesses who participated in the survey believe that tradespeople and engineers alike do not emerge from training with a sufficient understanding of business operations, and that recent engineering graduates and paraprofessionals are generally not regarded as being able to produce practical solutions.

7.1 Key Recommendations

Based on the results of this project, the main priorities for training providers to support the skill requirements arising from emerging technologies are:

- Ensure that training adequately provides the core and practical skills required for trade-based, para-professional and professional personnel;
- Develop processes that will allow training facilities and programs to expose students to the newer technologies in their respective fields;
- Develop courses that deliver the skill requirements relevant to the technologies employed by Tech-enabled companies;
- Develop programs and resources that support Conservative companies to enhance their knowledge of new and emerging technologies and the adoption of those technologies;
- Develop complementary training programs for both trade and university graduates in:
    - product costing;
    - production management;
    - business skills; and
    - innovative manufacturing practices (e.g. lean manufacturing and competitive manufacturing).
- Develop closer ties between SMEs and the trade-based training providers; and
- Ensure linkages between training organisations provide pathways for supplementary skill training, as required by Hunter Region SMEs.

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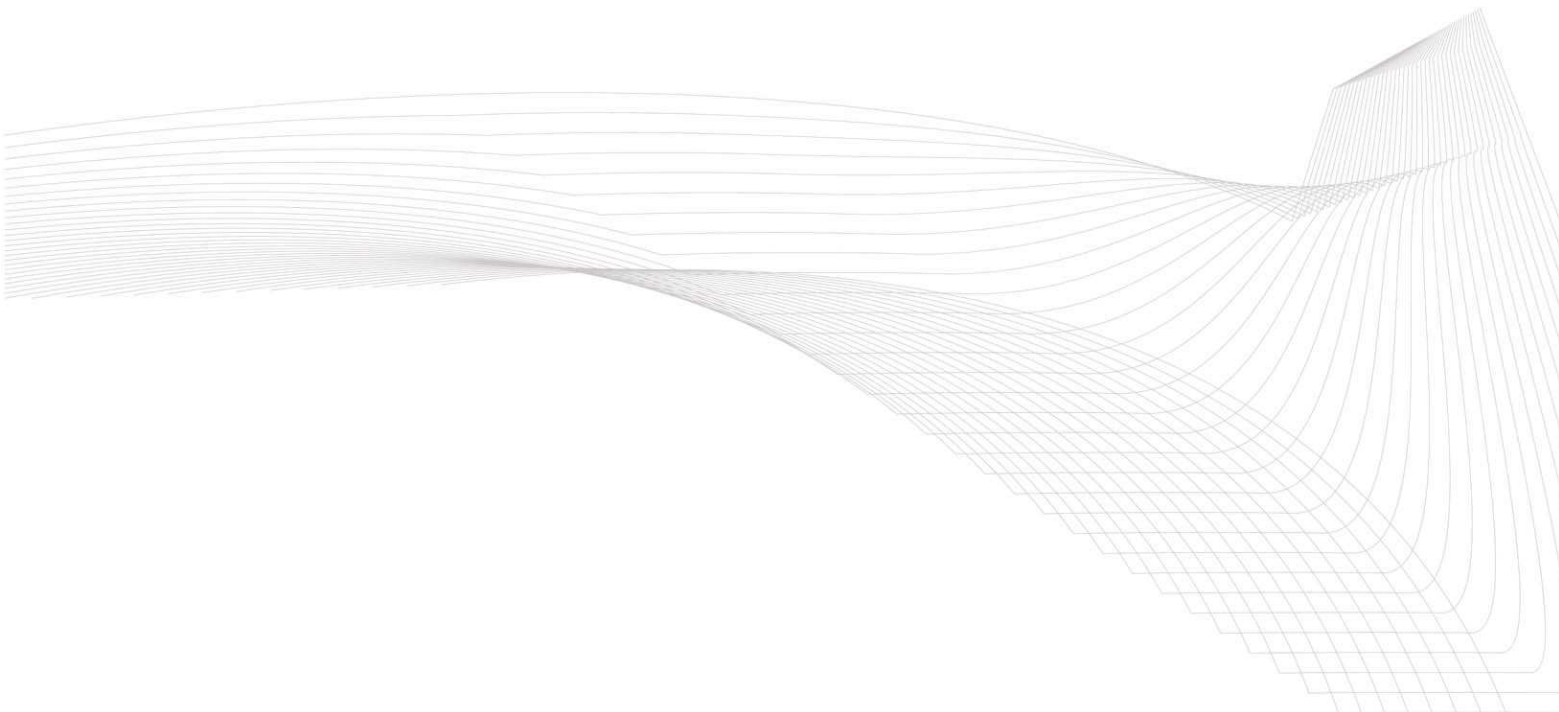
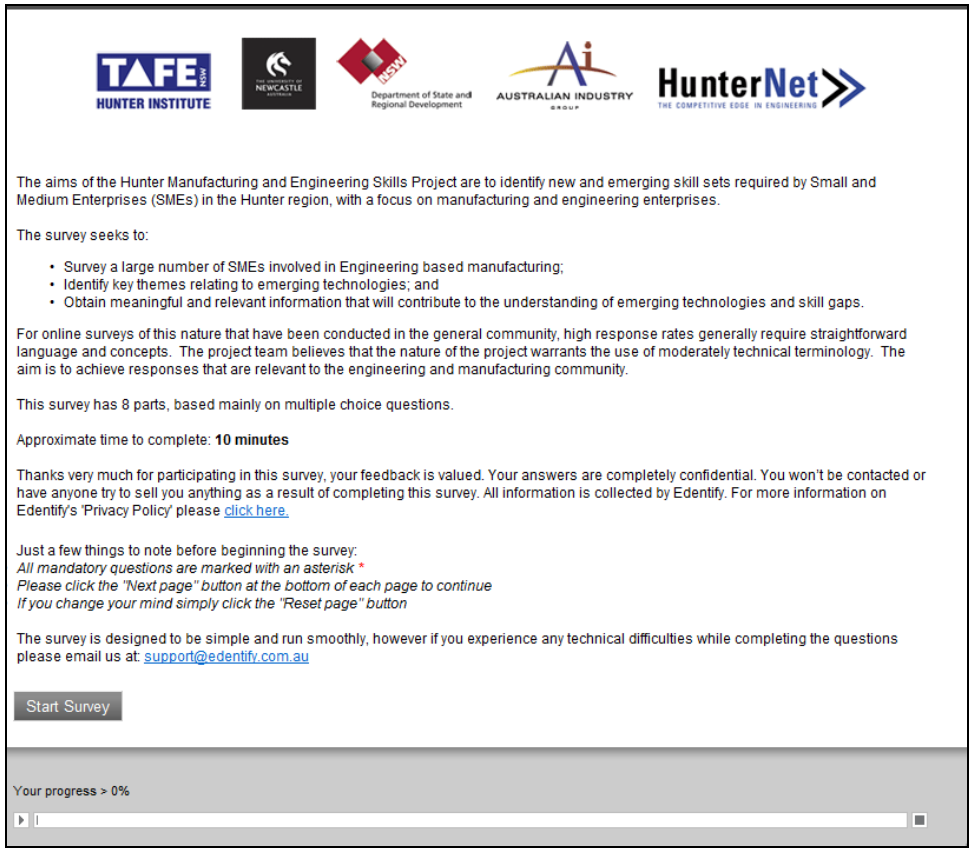
Hunter Manufacturing and Engineering
SKILLS PROJECT

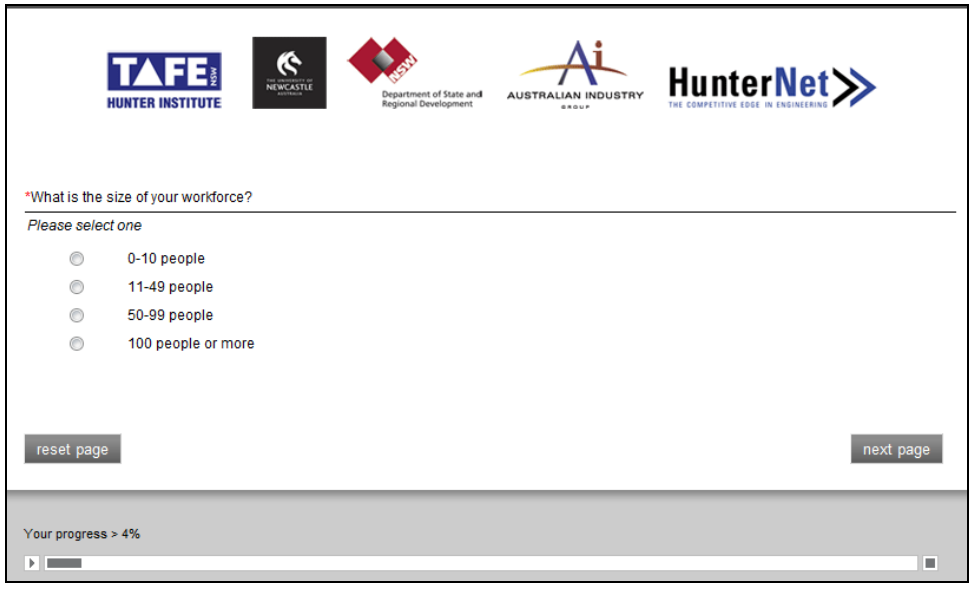
Appendix I

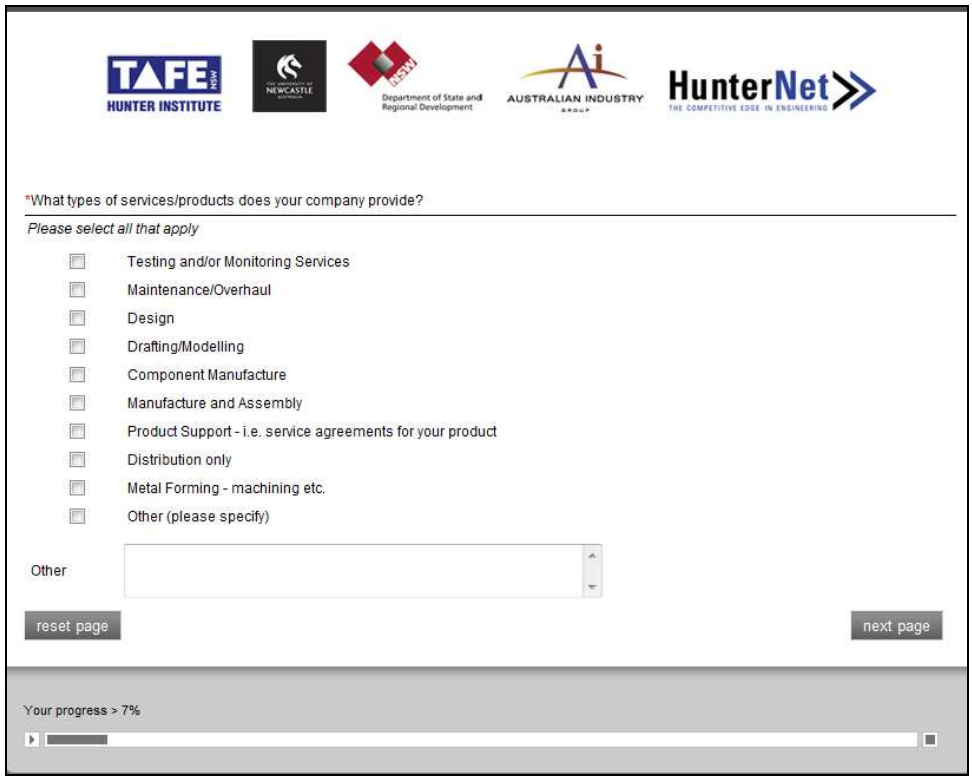
Online Survey



This appendix shows screenshots captured from the online survey that was active from the 5th May to the 20th May.



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HunterNet
THE COMPETITIVE EDGE IN ENGINEERING
*What types of services/products does your company provide?
Please select all that apply
Testing and/or Monitoring Services
Maintenance/Overhaul
Design
Drafting/Modelling
Component Manufacture
Manufacture and Assembly
Product Support - i.e. service agreements for your product
Distribution only
Metal Forming - machining etc.
Other (please specify)
Other
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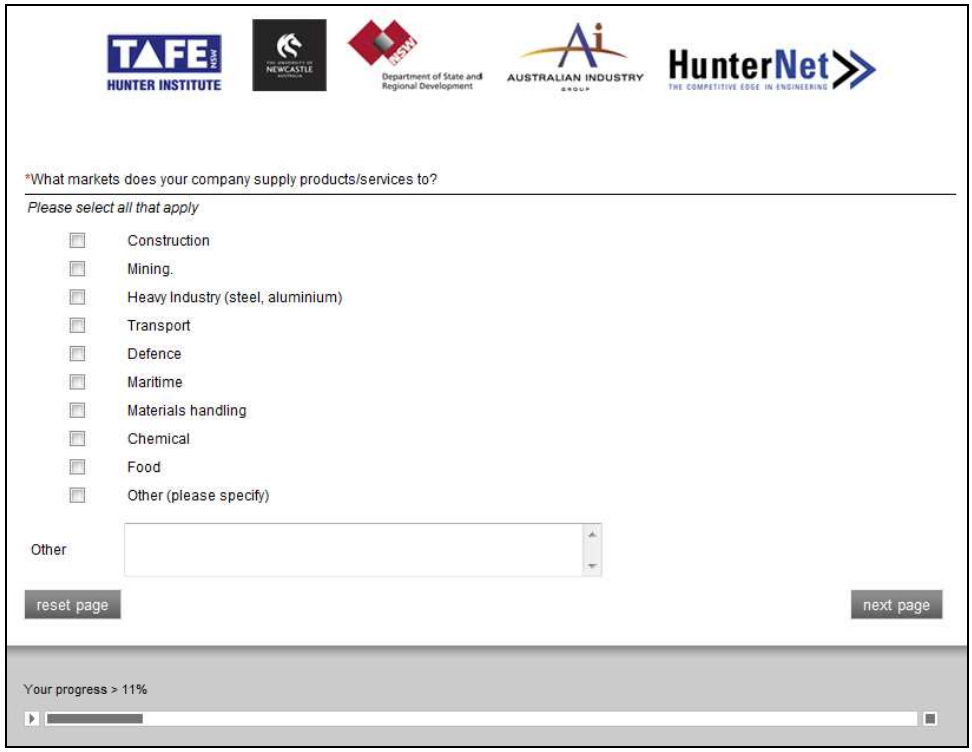
Your progress > 7%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Department of State and Regional Development
AUSTRALIAN INDUSTRY GROUP
HunterNet
THE COMPETITIVE EDGE IN ENGINEERING
*What markets does your company supply products/services to?
Please select all that apply
Construction
Mining.
Heavy Industry (steel, aluminium)
Transport
Defence
Maritime
Materials handling
Chemical
Food
Other (please specify)
Other
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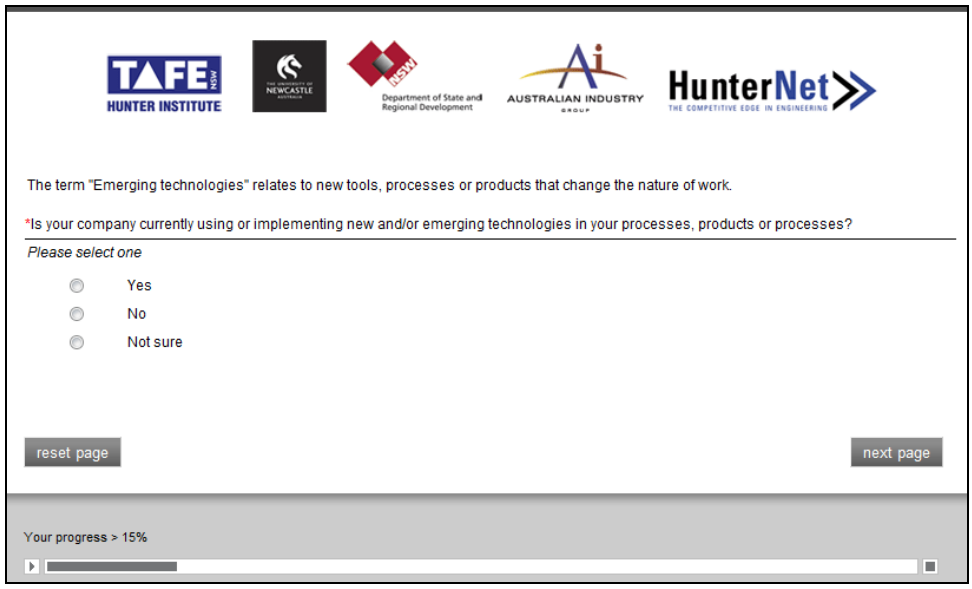
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NEWCASTLE
Department of State and Regional Development
AUSTRALIAN INDUSTRY
HunterNet
THE COMPETITIVE EDGE IN ENGINEERING
The term "Emerging technologies" relates to new tools, processes or products that change the nature of work.
*Is your company currently using or implementing new and/or emerging technologies in your processes, products or processes?
Please select one
Yes
No
Not sure
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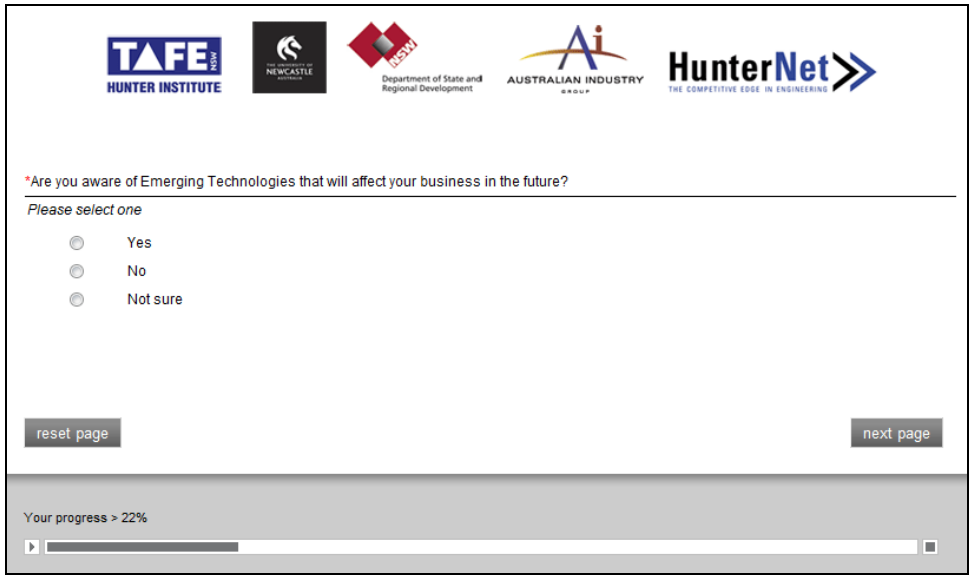
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*Are you aware of Emerging Technologies that will affect your business in the future?
Please select one
Yes
No
Not sure
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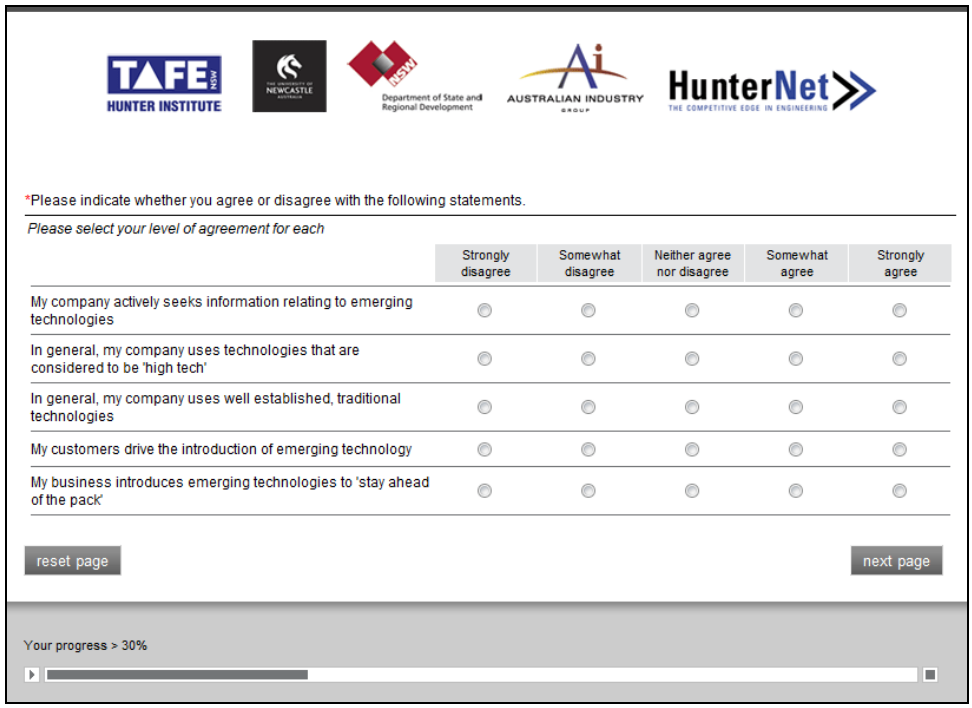
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THE COMPETITIVE EDGE IN ENGINEERING
*Please indicate whether you agree or disagree with the following statements.
Please select your level of agreement for each
Strongly disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Strongly agree
My company actively seeks information relating to emerging technologies
In general, my company uses technologies that are considered to be 'high tech'
In general, my company uses well established, traditional technologies
My customers drive the introduction of emerging technology
My business introduces emerging technologies to 'stay ahead of the pack'
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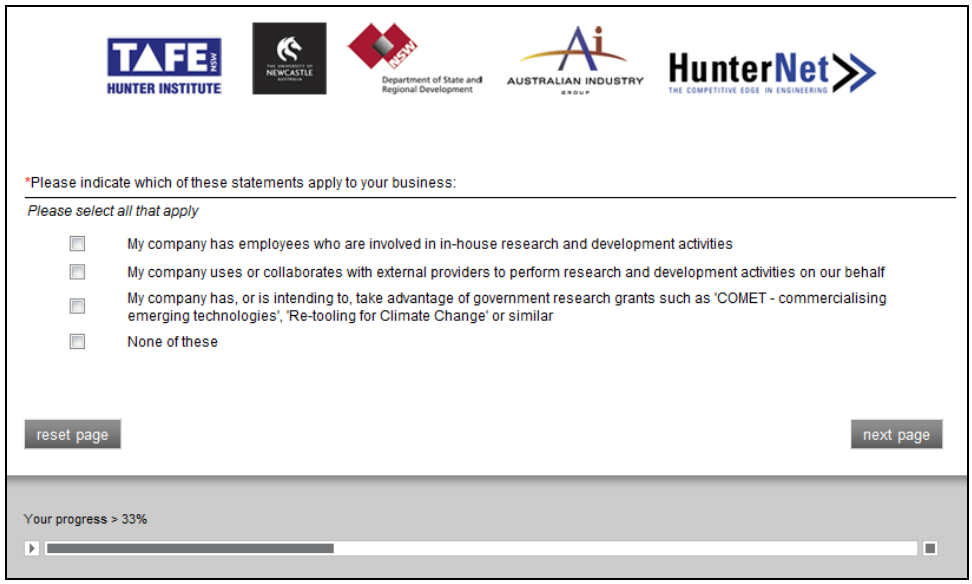
Your progress > 30%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Department of State and Regional Development
AUSTRALIAN INDUSTRY
HunterNet
THE COMPETITIVE EDGE IN ENGINEERING
*Please indicate which of these statements apply to your business:
Please select all that apply
My company has employees who are involved in in-house research and development activities
My company uses or collaborates with external providers to perform research and development activities on our behalf
My company has, or is intending to, take advantage of government research grants such as 'COMET - commercialising emerging technologies', 'Re-tooling for Climate Change' or similar
None of these
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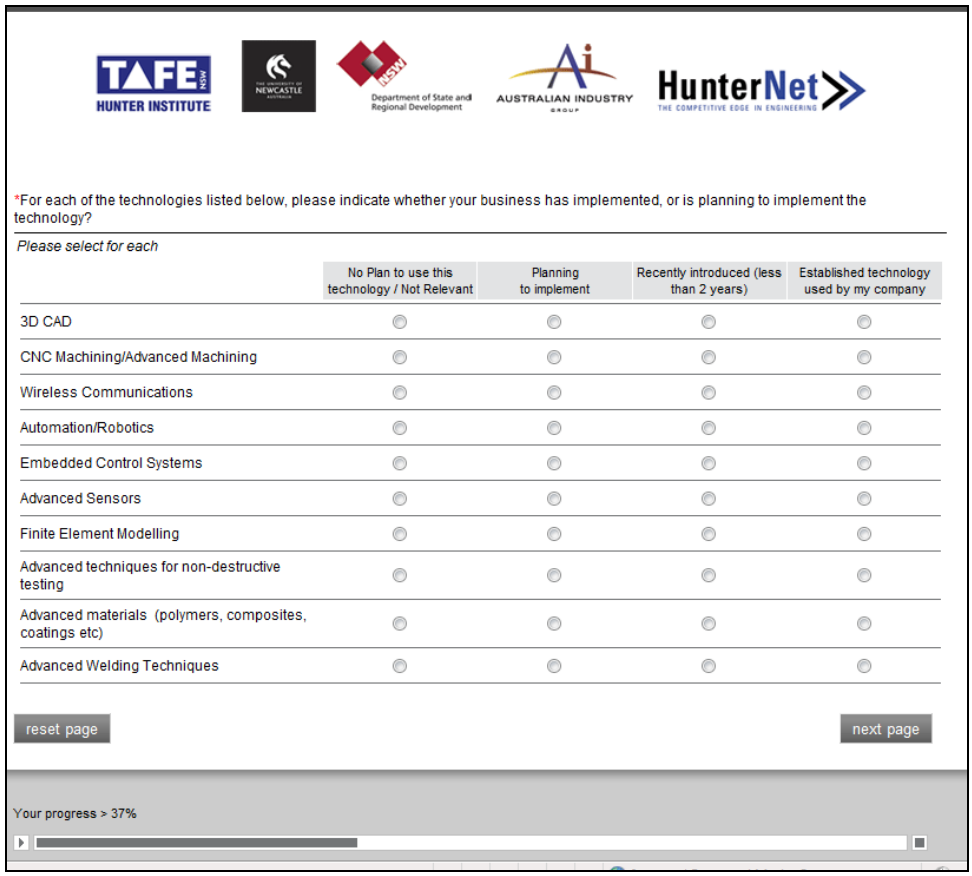
Your progress > 33%



*For each of the technologies listed below, please indicate whether your business has implemented, or is planning to implement the technology?

Please select for each

	No Plan to use this technology / Not Relevant	Planning to implement	Recently introduced (less than 2 years)	Established technology used by my company
3D CAD	○	○	○	○
CNC Machining/Advanced Machining	○	○	○	○
Wireless Communications	○	○	○	○
Automation/Robotics	○	○	○	○
Embedded Control Systems	○	○	○	○
Advanced Sensors	○	○	○	○
Finite Element Modelling	○	○	○	○
Advanced techniques for non-destructive testing	○	○	○	○
Advanced materials (polymers, composites, coatings etc)	○	○	○	○
Advanced Welding Techniques	○	○	○	○

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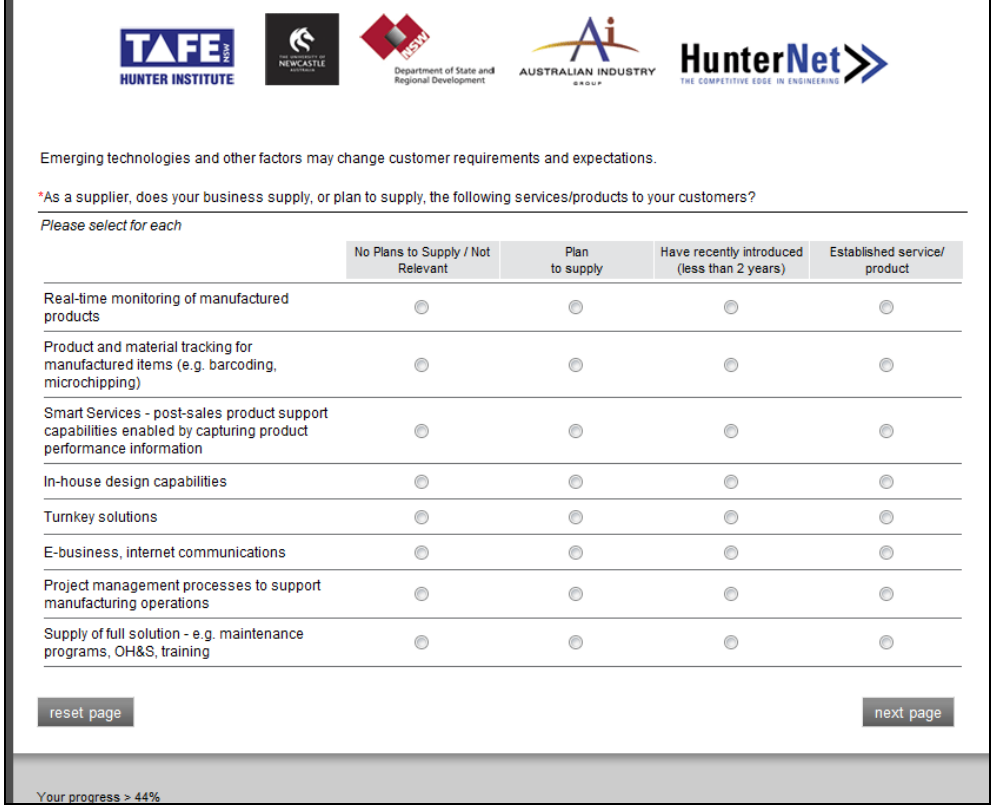
Your progress > 37%



Emerging technologies and other factors may change customer requirements and expectations.

*As a supplier, does your business supply, or plan to supply, the following services/products to your customers?

Please select for each

	No Plans to Supply / Not Relevant	Plan to supply	Have recently introduced (less than 2 years)	Established service/ product
Real-time monitoring of manufactured products	○	○	○	○
Product and material tracking for manufactured items (e.g. barcoding, microchipping)	○	○	○	○
Smart Services - post-sales product support capabilities enabled by capturing product performance information	○	○	○	○
In-house design capabilities	○	○	○	○
Turnkey solutions	○	○	○	○
E-business, internet communications	○	○	○	○
Project management processes to support manufacturing operations	○	○	○	○
Supply of full solution - e.g. maintenance programs, OH&S, training	○	○	○	○

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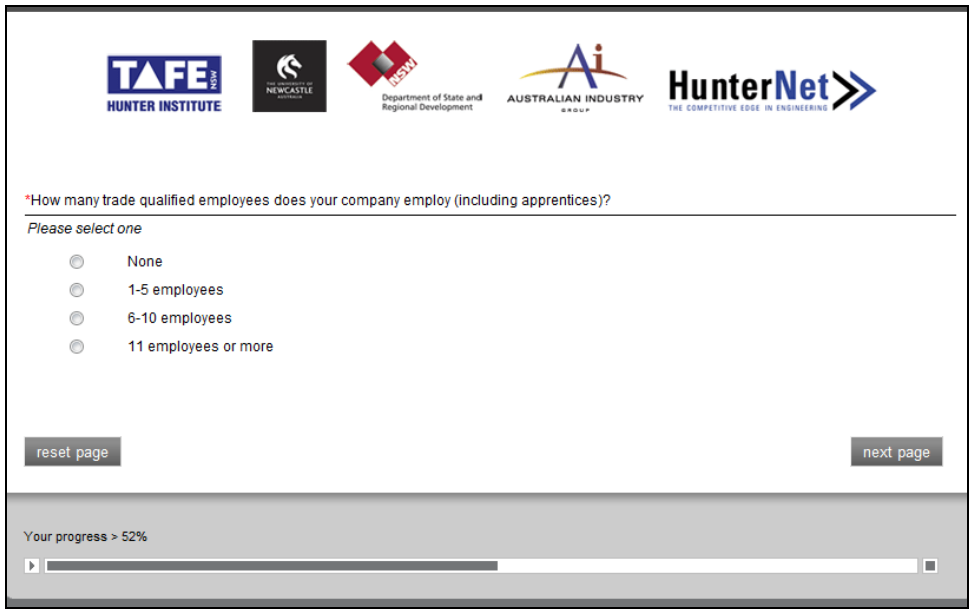
Your progress > 44%



*How many trade qualified employees does your company employ (including apprentices)?

Please select one

- None
- 1-5 employees
- 6-10 employees
- 11 employees or more

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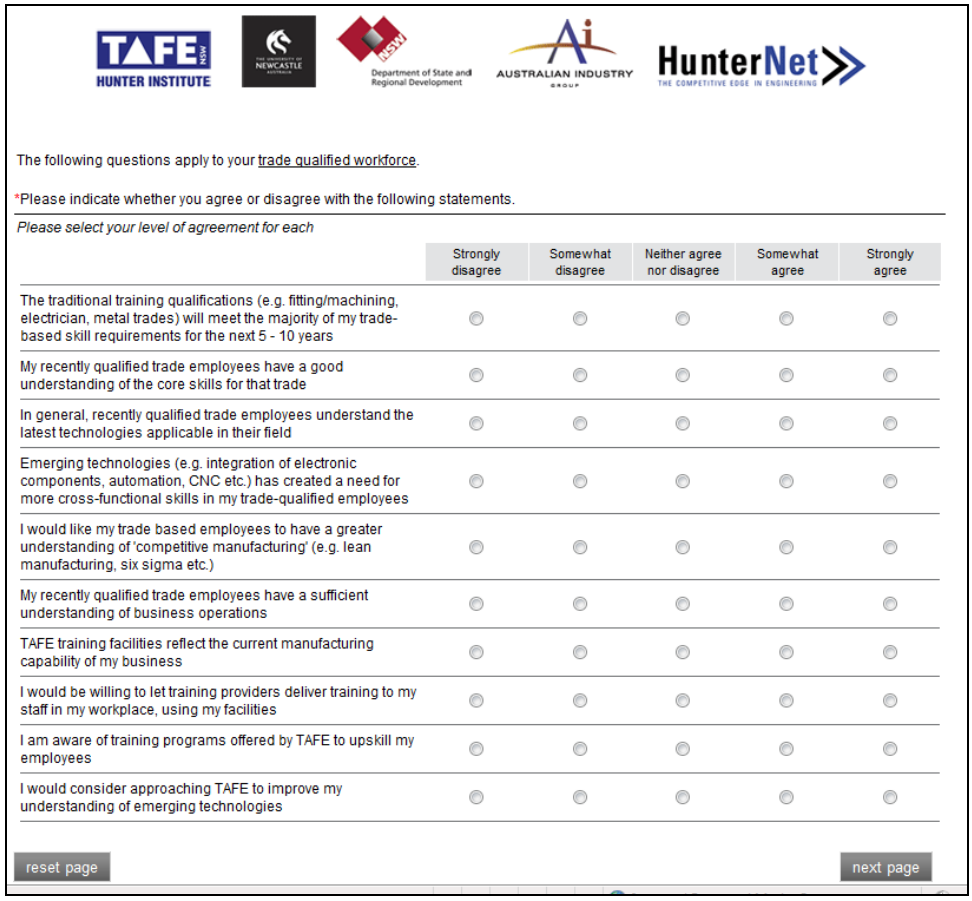
Your progress > 52%



The following questions apply to your trade qualified workforce.

*Please indicate whether you agree or disagree with the following statements.

Please select your level of agreement for each

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
The traditional training qualifications (e.g. fitting/machining, electrician, metal trades) will meet the majority of my trade-based skill requirements for the next 5 - 10 years					
My recently qualified trade employees have a good understanding of the core skills for that trade					
In general, recently qualified trade employees understand the latest technologies applicable in their field					
Emerging technologies (e.g. integration of electronic components, automation, CNC etc.) has created a need for more cross-functional skills in my trade-qualified employees					
I would like my trade based employees to have a greater understanding of 'competitive manufacturing' (e.g. lean manufacturing, six sigma etc.)					
My recently qualified trade employees have a sufficient understanding of business operations					
TAFE training facilities reflect the current manufacturing capability of my business					
I would be willing to let training providers deliver training to my staff in my workplace, using my facilities					
I am aware of training programs offered by TAFE to upskill my employees					
I would consider approaching TAFE to improve my understanding of emerging technologies					

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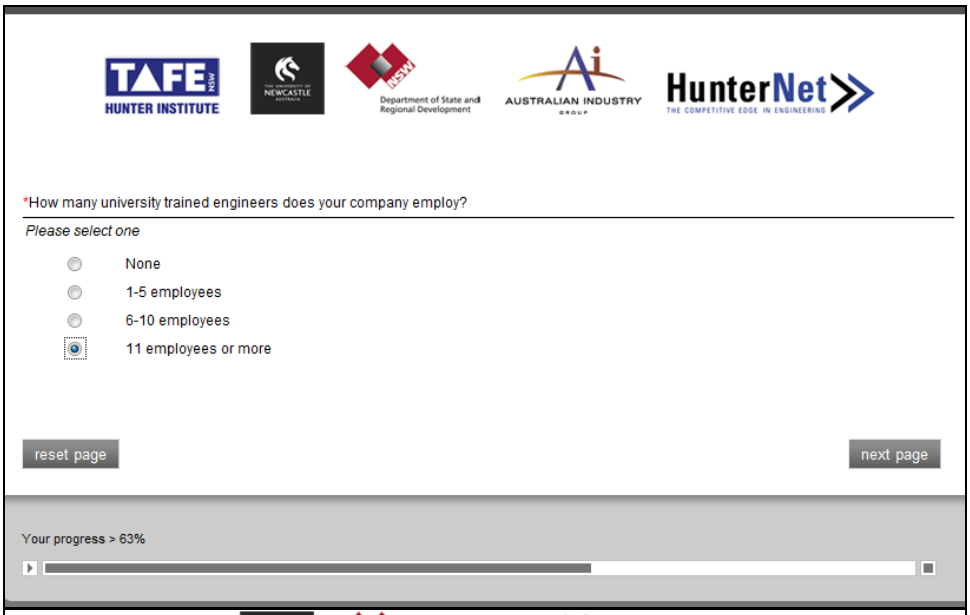

*How many university trained engineers does your company employ?

Please select one

- None
- 1-5 employees
- 6-10 employees
- 11 employees or more

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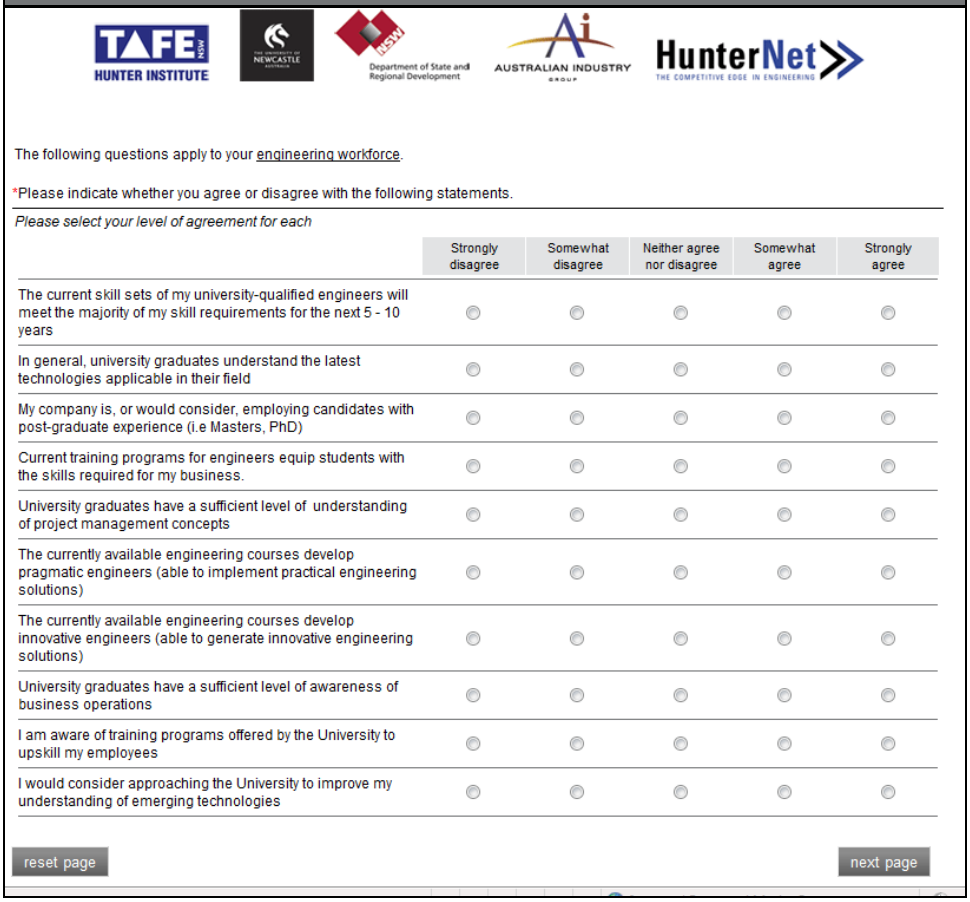
Your progress > 63%



The following questions apply to your engineering workforce.

*Please indicate whether you agree or disagree with the following statements.

Please select your level of agreement for each

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
The current skill sets of my university-qualified engineers will meet the majority of my skill requirements for the next 5 - 10 years					
In general, university graduates understand the latest technologies applicable in their field					
My company is, or would consider, employing candidates with post-graduate experience (i.e Masters, PhD)					
Current training programs for engineers equip students with the skills required for my business.					
University graduates have a sufficient level of understanding of project management concepts					
The currently available engineering courses develop pragmatic engineers (able to implement practical engineering solutions)					
The currently available engineering courses develop innovative engineers (able to generate innovative engineering solutions)					
University graduates have a sufficient level of awareness of business operations					
I am aware of training programs offered by the University to upskill my employees					
I would consider approaching the University to improve my understanding of emerging technologies					

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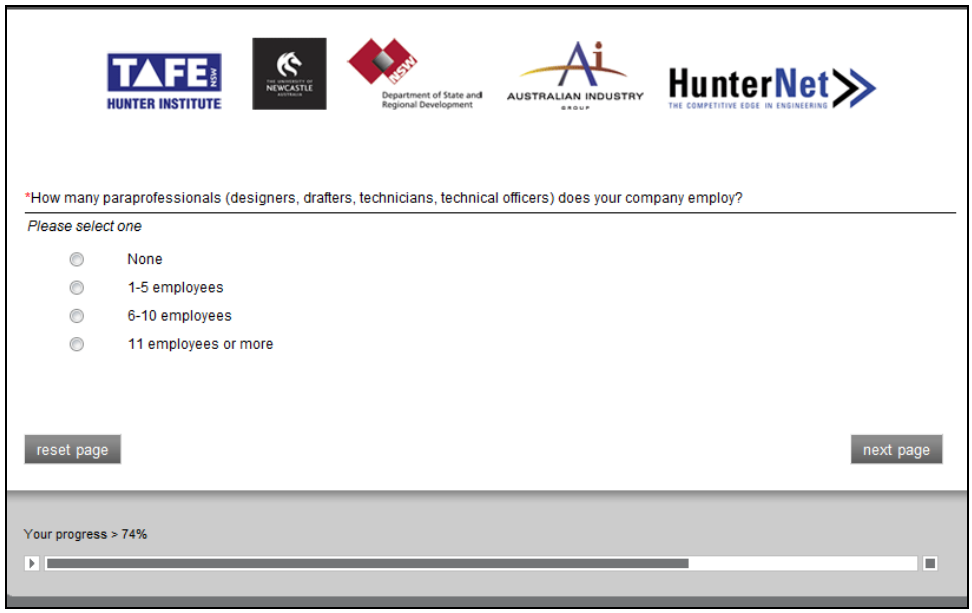
HUNTER INSTITUTE
Department of State and Regional Development
AUSTRALIAN INDUSTRY
HunterNet
THE COMPETITIVE EDGE IN ENGINEERING
*How many paraprofessionals (designers, drafters, technicians, technical officers) does your company employ?
Please select one
None
1-5 employees
6-10 employees
11 employees or more
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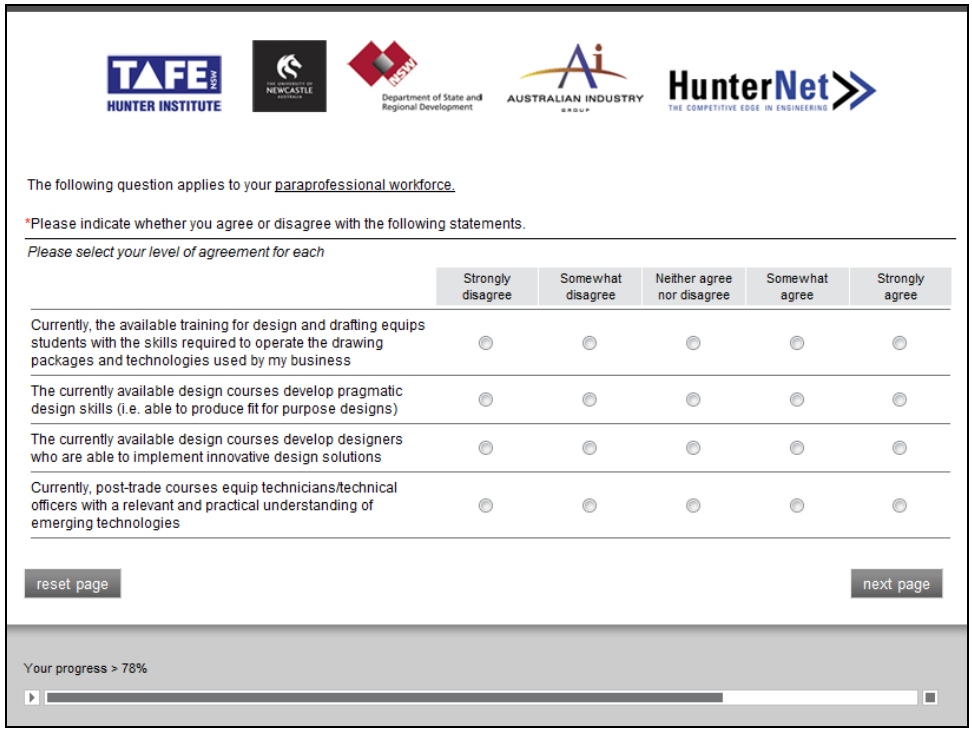
Your progress > 74%


HUNTER INSTITUTE
Department of State and Regional Development
AUSTRALIAN INDUSTRY
HunterNet
THE COMPETITIVE EDGE IN ENGINEERING
The following question applies to your paraprofessional workforce.
*Please indicate whether you agree or disagree with the following statements.
Please select your level of agreement for each
Strongly disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Strongly agree
Currently, the available training for design and drafting equips students with the skills required to operate the drawing packages and technologies used by my business
The currently available design courses develop pragmatic design skills (i.e. able to produce fit for purpose designs)
The currently available design courses develop designers who are able to implement innovative design solutions
Currently, post-trade courses equip technicians/technical officers with a relevant and practical understanding of emerging technologies
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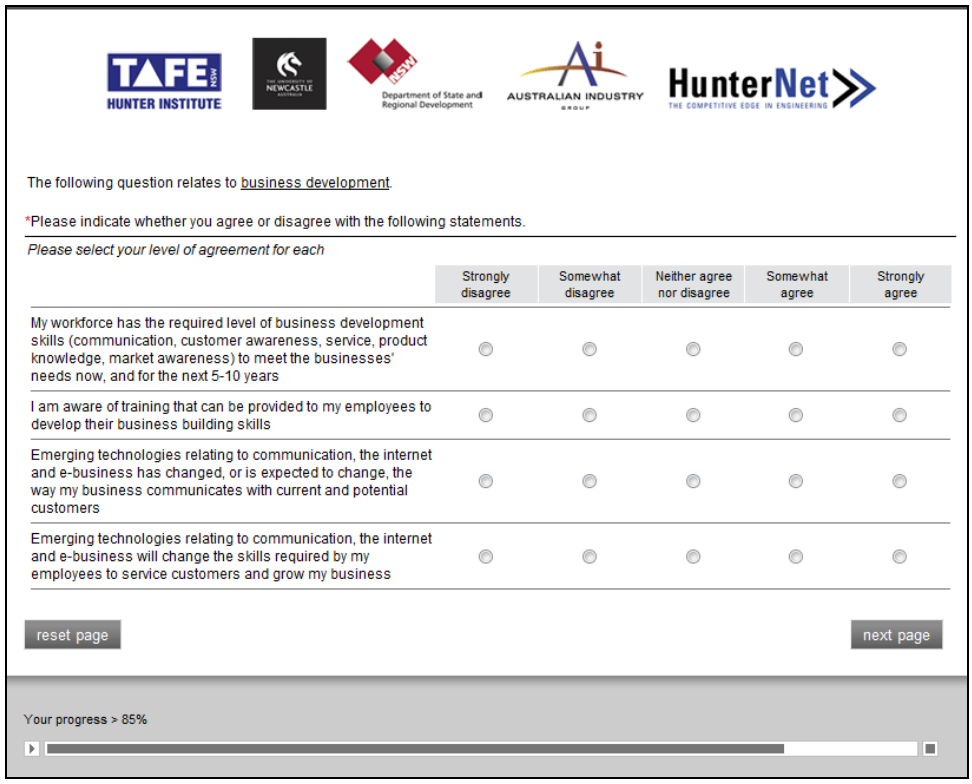
Your progress > 78%



The following question relates to business development.

*Please indicate whether you agree or disagree with the following statements.

Please select your level of agreement for each

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
My workforce has the required level of business development skills (communication, customer awareness, service, product knowledge, market awareness) to meet the businesses' needs now, and for the next 5-10 years	○	○	○	○	○
I am aware of training that can be provided to my employees to develop their business building skills	○	○	○	○	○
Emerging technologies relating to communication, the internet and e-business has changed, or is expected to change, the way my business communicates with current and potential customers	○	○	○	○	○
Emerging technologies relating to communication, the internet and e-business will change the skills required by my employees to service customers and grow my business	○	○	○	○	○

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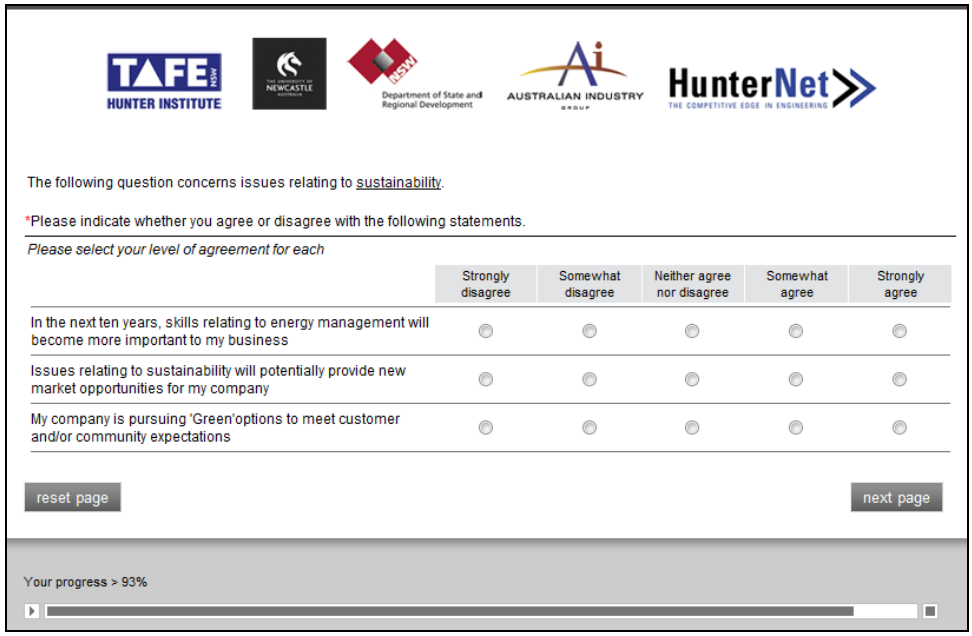
Your progress > 85%



The following question concerns issues relating to sustainability.

*Please indicate whether you agree or disagree with the following statements.

Please select your level of agreement for each

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
In the next ten years, skills relating to energy management will become more important to my business	○	○	○	○	○
Issues relating to sustainability will potentially provide new market opportunities for my company	○	○	○	○	○
My company is pursuing 'Green'options to meet customer and/or community expectations	○	○	○	○	○

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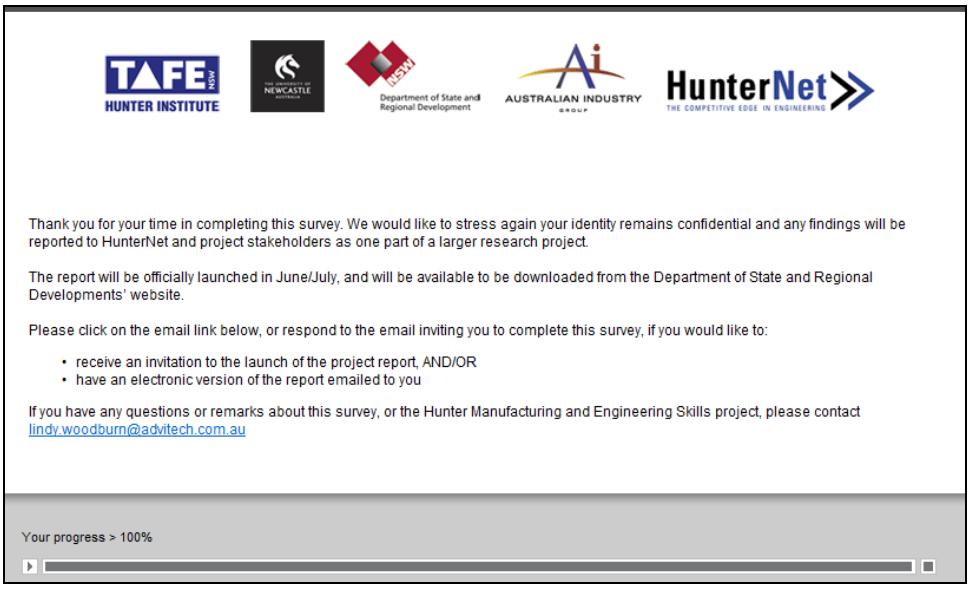
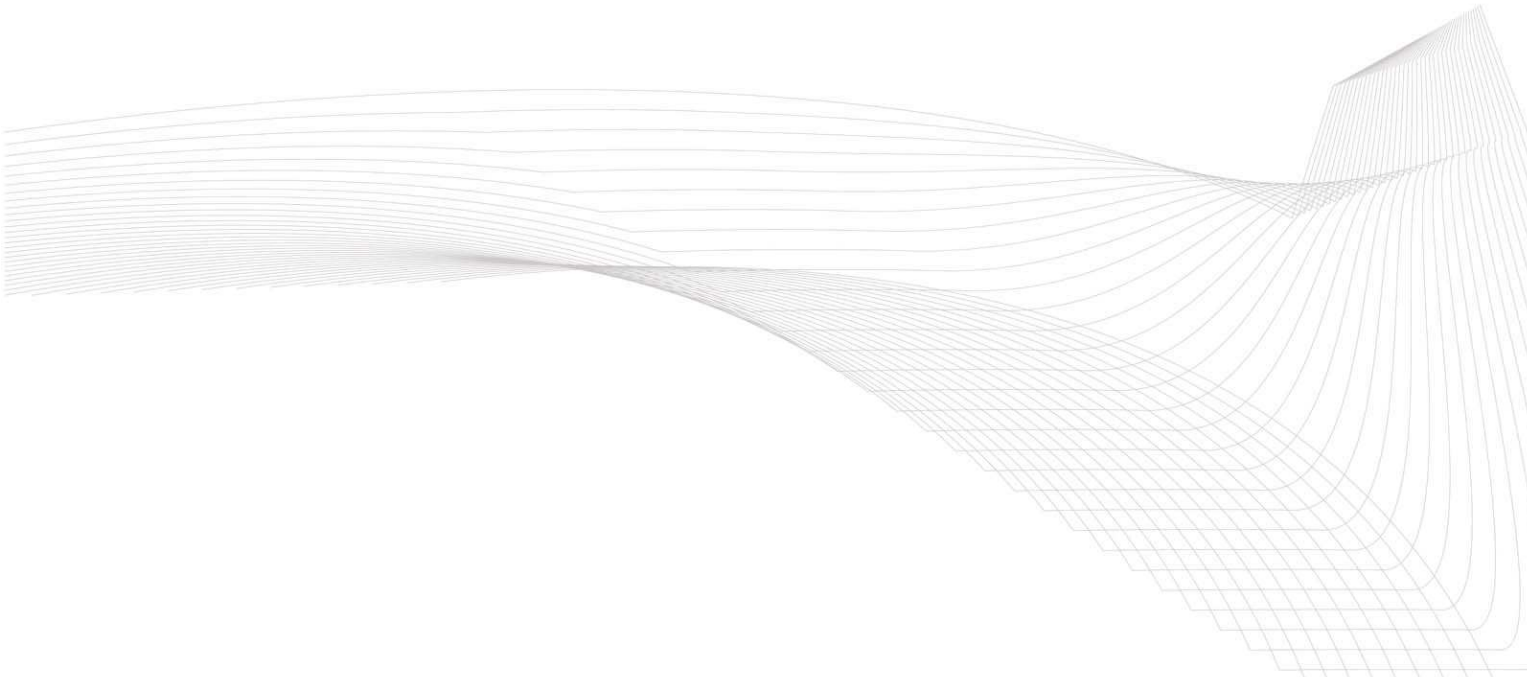
Your progress > 93%


TAFE NSW
HUNTER INSTITUTE
NEWCASTLE
NSW
Department of State and Regional Development
AUSTRALIAN INDUSTRY GROUP
HunterNet
THE COMPETITIVE EDGE IN ENGINEERING
Thank you for your time in completing this survey. We would like to stress again your identity remains confidential and any findings will be reported to HunterNet and project stakeholders as one part of a larger research project.
The report will be officially launched in June/July, and will be available to be downloaded from the Department of State and Regional Developments' website.
Please click on the email link below, or respond to the email inviting you to complete this survey, if you would like to:
• receive an invitation to the launch of the project report, AND/OR
• have an electronic version of the report emailed to you
If you have any questions or remarks about this survey, or the Hunter Manufacturing and Engineering Skills project, please contact lindy.woodburn@advitech.com.au
Your progress > 100%

Hunter Manufacturing and Engineering
SKILLS PROJECT

Appendix II

Survey Results



DEMOGRAPHICS

Responses	
Date	**2**
5-May-09	7
6-May-09	1
7-May-09	5
8-May-09	5
11-May-09	12
12-May-09	7
12-May-09	6
TOTAL	**43**

Demographics	
5	**Q1.1**
0-10 people	6
11-49 people	22
50-99 people	9
100 people or more	6
TOTAL	**43**

No. Trade Based	
63	**Q5.1**
1-5 employees	7
6-10 employees	5
11 employees or more	30
None	1
TOTAL	**43**

No. University	
75	**Q6.1**
1-5 employees	19
6-10 employees	6
11 employees or more	2
None	16
Sub - employeeing	**27**
All	**43**

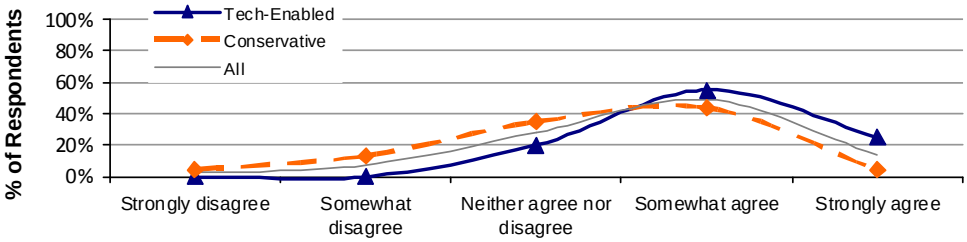
No. Paraprofessional	
87	**Q7.1**
1-5 employees	21
6-10 employees	5
11 employees or more	2
None	15
TOTAL	**43**

Services/Products		Yes	No
6	**Q1.2_Testing and/or Monitoring**	7	36
7	**Q1.2_Maintenance/Overhaul**	19	24
8	**Q1.2_Design**	12	31
9	**Q1.2_Drafting/Modelling**	14	29
10	**Q1.2_Component Manufacture**	19	24
11	**Q1.2_Manufacture and Assembly**	30	13
12	**Q1.2_Product Support - i.e. servi**	11	32
13	**Q1.2_Distribution only**	4	39
14	**Q1.2_Metal Forming - machining**	18	25
15	**Q1.2_Other (please specify)**	9	34

Industries		Yes	No
17	**Q1.3_Construction**	24	19
18	**Q1.3_Mining.**	36	7
19	**Q1.3_Heavy Industry (steel alum**	22	21
20	**Q1.3_Transport**	15	28
21	**Q1.3_Defence**	9	34
22	**Q1.3_Maritime**	11	32
23	**Q1.3_Materials handling**	17	26
24	**Q1.3_Chemical**	8	35
25	**Q1.3_Food**	6	37
26	**Q1.3_Other (please specify)**	8	35

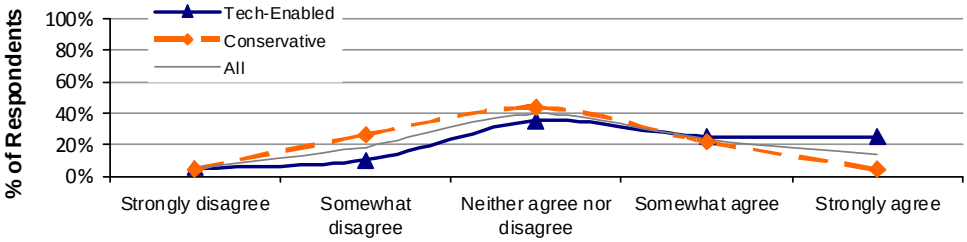
Q2.5 My company actively seeks information relating to emerging technologies

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	0%	0%	20%	55%	25%	Tech-Enabled	0%	20%	80%
No/Not Sure	4%	13%	35%	43%	4%	Conserv.	17%	35%	48%
ALL	**2%**	**7%**	**28%**	**49%**	**14%**	**ALL**	**9%**	**28%**	**63%**



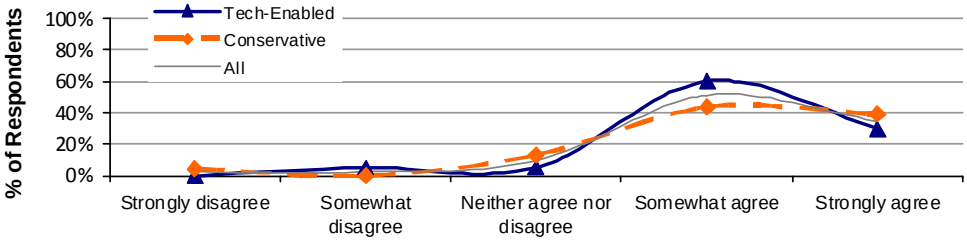
Q2.5 In general my company uses technologies that are considered to be "high tech"

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	5%	10%	35%	25%	25%	Tech-Enabled	15%	35%	50%
No/Not Sure	4%	26%	43%	22%	4%	Conserv.	30%	43%	26%
ALL	**5%**	**19%**	**40%**	**23%**	**14%**	**ALL**	**23%**	**40%**	**37%**



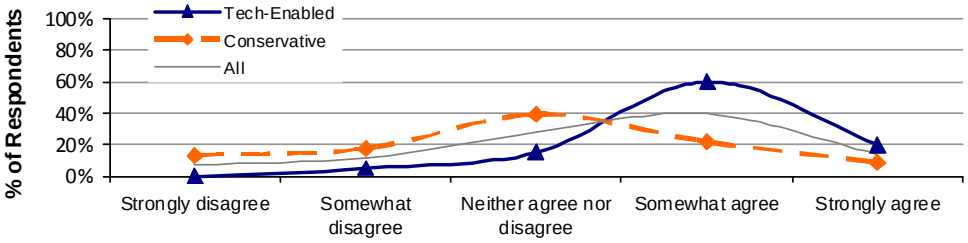
Q2.5 In general my company uses well established traditional technologies

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	0%	5%	5%	60%	30%	Tech-Enabled	5%	5%	90%
No/Not Sure	4%	0%	13%	43%	39%	Conserv.	4%	13%	83%
ALL	**2%**	**2%**	**9%**	**51%**	**35%**	**ALL**	**5%**	**9%**	**86%**



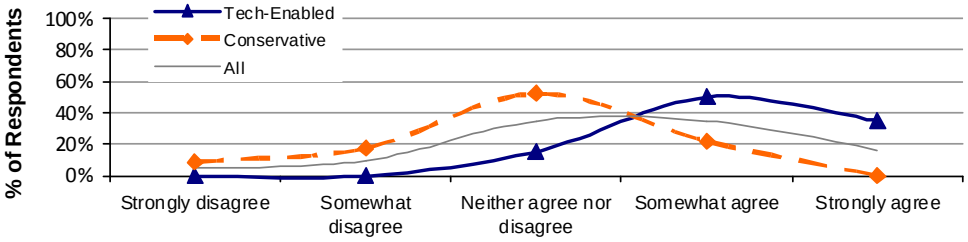
Q2.5 My customers drive the introduction of emerging technology

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	0%	5%	15%	60%	20%	Tech-Enabled	5%	15%	80%
No/Not Sure	13%	17%	39%	22%	9%	Conserv.	30%	39%	30%
ALL	**7%**	**12%**	**28%**	**40%**	**14%**	**ALL**	**19%**	**28%**	**53%**



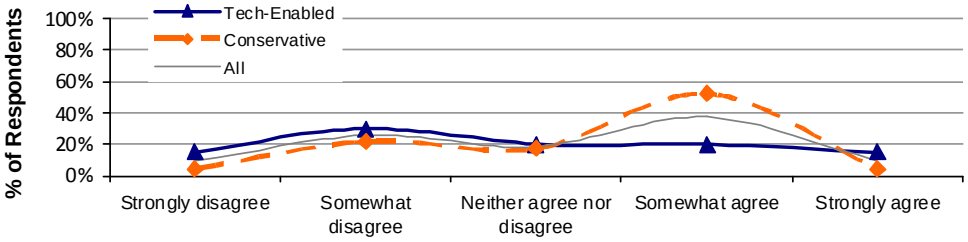
Q2.5 My business introduces emerging technologies to "stay ahead of the pack"

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	0%	0%	15%	50%	35%	Tech-Enabled	0%	15%	85%
No/Not Sure	9%	17%	52%	22%	0%	Conserv.	26%	52%	22%
ALL	**5%**	**9%**	**35%**	**35%**	**16%**	**ALL**	**14%**	**35%**	**51%**



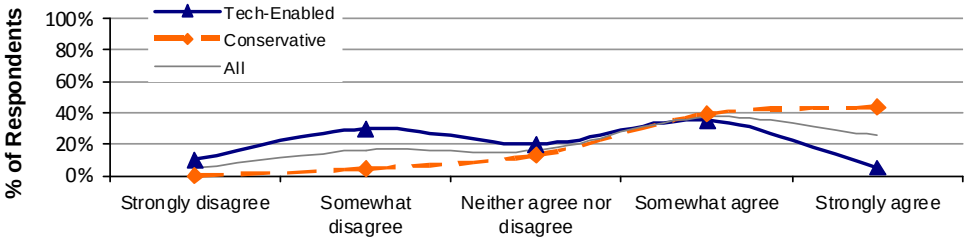
Q4.1 The skill sets of my current workforce will meet the skill requirements of my business now and for the next 5-10 years

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	15%	30%	20%	20%	15%	Tech-Enabled	45%	20%	35%
No/Not Sure	4%	22%	17%	52%	4%	Conserv.	26%	17%	57%
ALL	**9%**	**26%**	**19%**	**37%**	**9%**	**ALL**	**35%**	**19%**	**47%**



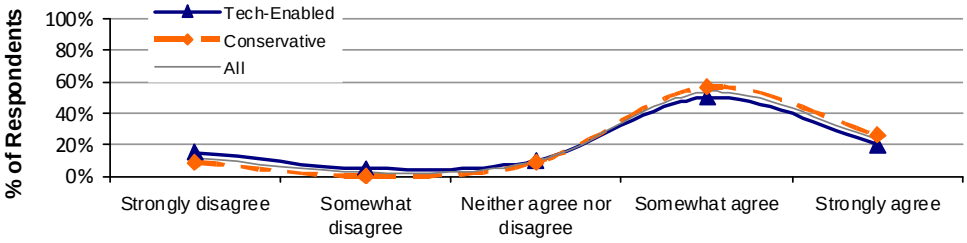
Q4.1 Hunter-based training providers (e.g. TAFE, University of Newcastle) are able to provide training for the majority of the technology-based skills I required for my workforce

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	10%	30%	20%	35%	5%	Tech-Enabled	40%	20%	40%
No/Not Sure	0%	4%	13%	39%	43%	Conserv.	4%	13%	83%
ALL	**5%**	**16%**	**16%**	**37%**	**26%**	**ALL**	**21%**	**16%**	**63%**



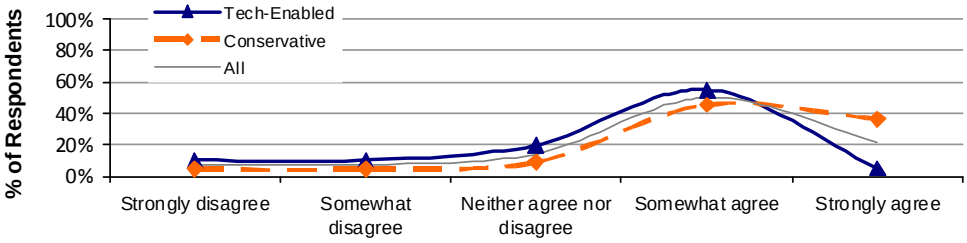
Q4.1 Skills gaps in my workforce (inadequate levels of skills in the labour pool) have been an issue for my company in the last twelve months

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	15%	5%	10%	50%	20%	Tech-Enabled	20%	10%	70%
No/Not Sure	9%	0%	9%	57%	26%	Conserv.	9%	9%	83%
ALL	**12%**	**2%**	**9%**	**53%**	**23%**	**ALL**	**14%**	**9%**	**77%**



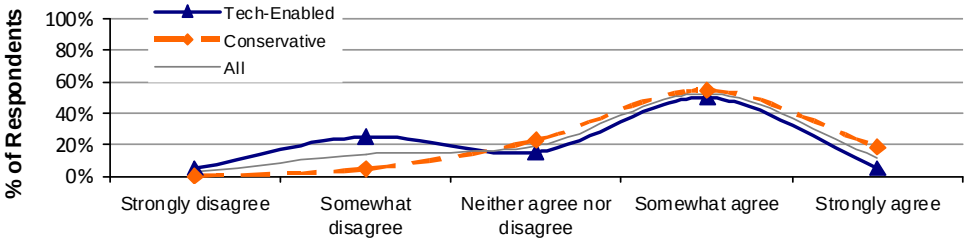
Q5.2 The traditional training qualifications (e.g. fitting/machining electrician metal trades) will meet the majority of my trade-based skill requirements for the next 5-10 years

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	10%	10%	20%	55%	5%	Tech-Enabled	20%	20%	60%
No/Not Sure	5%	5%	9%	45%	36%	Conserv.	9%	9%	82%
ALL	**7%**	**7%**	**14%**	**50%**	**21%**	**ALL**	**14%**	**14%**	**71%**



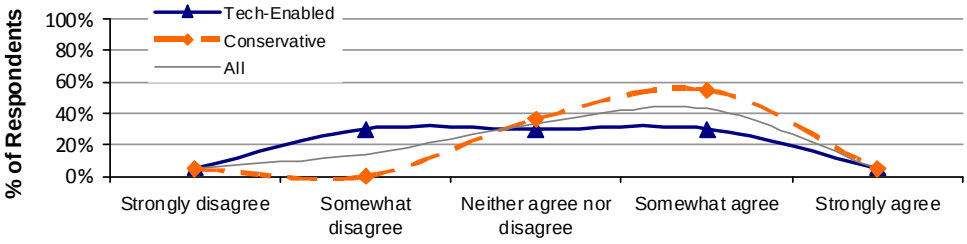
Q5.2 My recently qualified trade employees have a good understanding of the core skills for that trade

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	5%	25%	15%	50%	5%	Tech-Enabled	30%	15%	55%
No/Not Sure	0%	5%	23%	55%	18%	Conserv.	5%	23%	73%
ALL	**2%**	**14%**	**19%**	**52%**	**12%**	**ALL**	**17%**	**19%**	**64%**



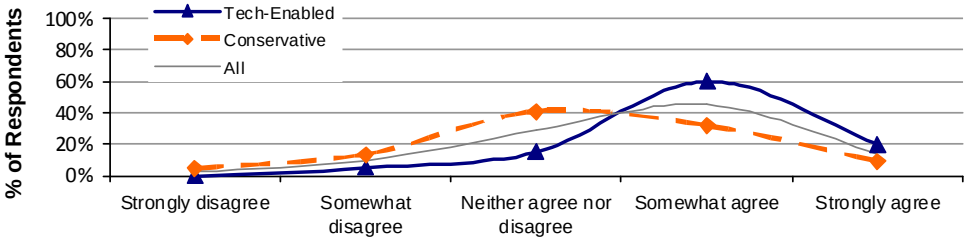
Q5.2 In general recently qualified trade employees understand the latest technologies applicable in their field

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	5%	30%	30%	30%	5%	Tech-Enabled	35%	30%	35%
No/Not Sure	5%	0%	36%	55%	5%	Conserv.	5%	36%	59%
ALL	**5%**	**14%**	**33%**	**43%**	**5%**	**ALL**	**19%**	**33%**	**48%**



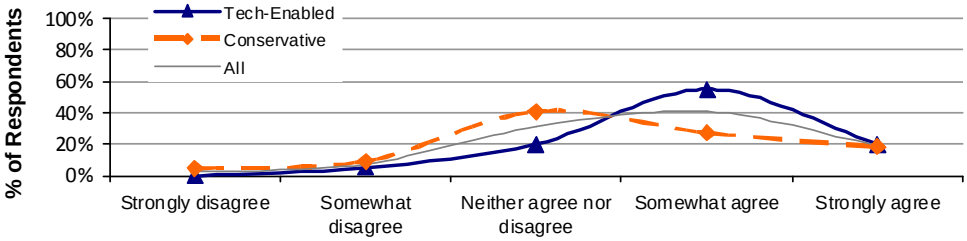
Q5.2 Emerging technologies (e.g. integration of electronic components, automation, CNC etc.) has created a need for more cross-functional skills in my trade-qualified employees

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	0%	5%	15%	60%	20%	Tech-Enabled	5%	15%	80%
No/Not Sure	5%	14%	41%	32%	9%	Conserv.	18%	41%	41%
ALL	**2%**	**10%**	**29%**	**45%**	**14%**	**ALL**	**12%**	**29%**	**60%**



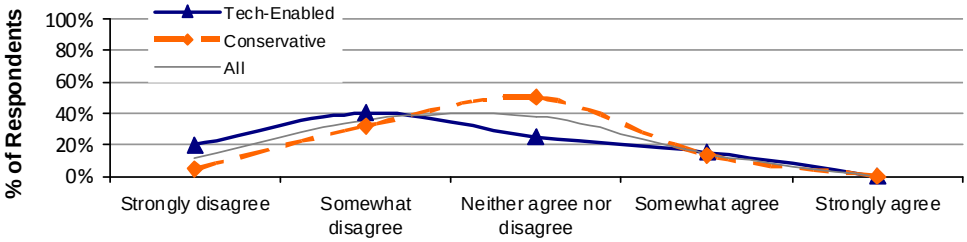
Q5.2 I would like my trade based employees to have a greater understanding of 'competitive manufacturing'; (e.g. lean manufacturing, six sigma etc.)

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	0%	5%	20%	55%	20%	Tech-Enabled	5%	20%	75%
No/Not Sure	5%	9%	41%	27%	18%	Conserv.	14%	41%	45%
ALL	**2%**	**7%**	**31%**	**40%**	**19%**	**ALL**	**10%**	**31%**	**60%**



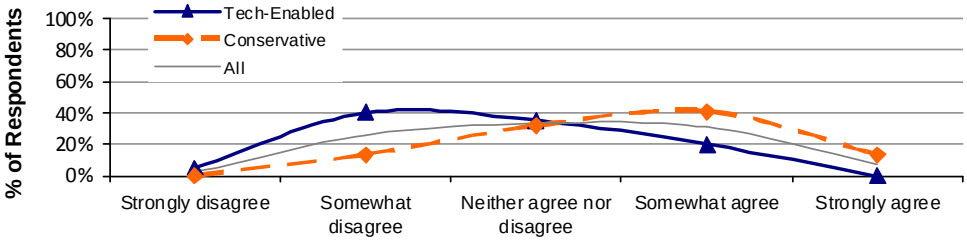
Q5.2 My recently qualified trade employees have a sufficient understanding of business operations

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	20%	40%	25%	15%	0%	Tech-Enabled	60%	25%	15%
No/Not Sure	5%	32%	50%	14%	0%	Conserv.	36%	50%	14%
ALL	**12%**	**36%**	**38%**	**14%**	**0%**	**ALL**	**48%**	**38%**	**14%**



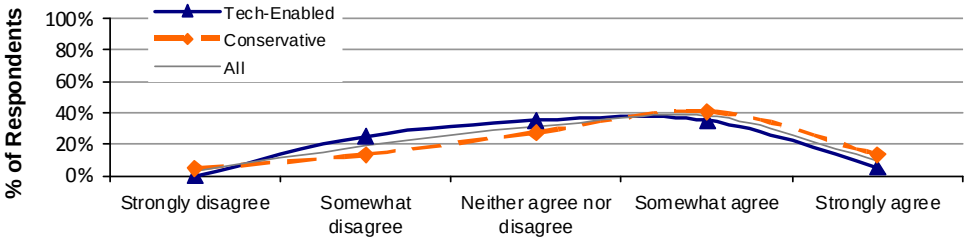
Q5.2 TAFE training facilities reflect the current manufacturing capability of my business

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	5%	40%	35%	20%	0%	Tech-Enabled	45%	35%	20%
No/Not Sure	0%	14%	32%	41%	14%	Conserv.	14%	32%	55%
ALL	**2%**	**26%**	**33%**	**31%**	**7%**	**ALL**	**29%**	**33%**	**38%**



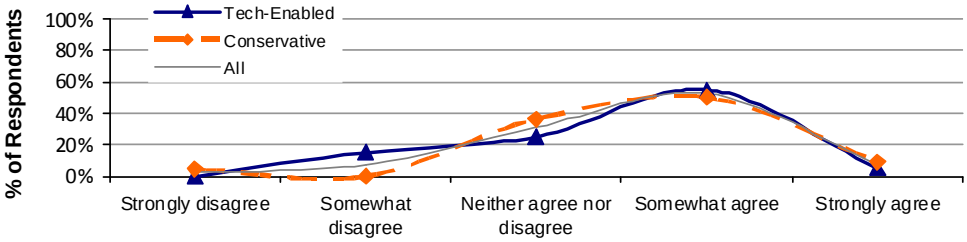
Q5.2 I would be willing to let training providers deliver training to my staff in my workplace using my facilities

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	0%	25%	35%	35%	5%	Tech-Enabled	25%	35%	40%
No/Not Sure	5%	14%	27%	41%	14%	Conserv.	18%	27%	55%
ALL	**2%**	**19%**	**31%**	**38%**	**10%**	**ALL**	**21%**	**31%**	**48%**



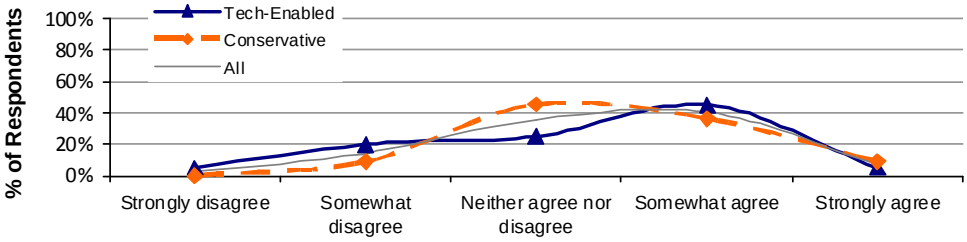
Q5.2 I am aware of training programs offered by TAFE to upskill my employees

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	0%	15%	25%	55%	5%	Tech-Enabled	15%	25%	60%
No/Not Sure	5%	0%	36%	50%	9%	Conserv.	5%	36%	59%
ALL	**2%**	**7%**	**31%**	**52%**	**7%**	**ALL**	**10%**	**31%**	**60%**



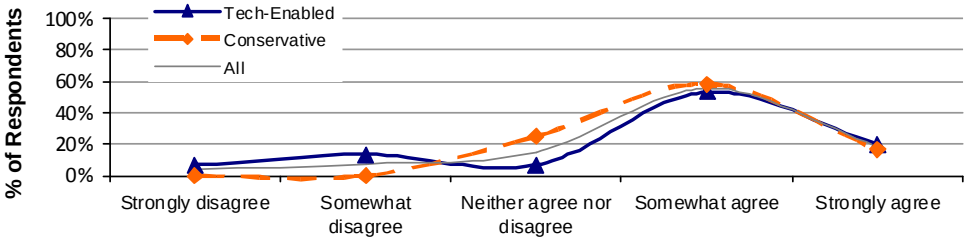
Q5.2 I would consider approaching TAFE to improve my understanding of emerging technologies

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	5%	20%	25%	45%	5%	Tech-Enabled	25%	25%	50%
No/Not Sure	0%	9%	45%	36%	9%	Conserv.	9%	45%	45%
ALL	**2%**	**14%**	**36%**	**40%**	**7%**	**ALL**	**17%**	**36%**	**48%**



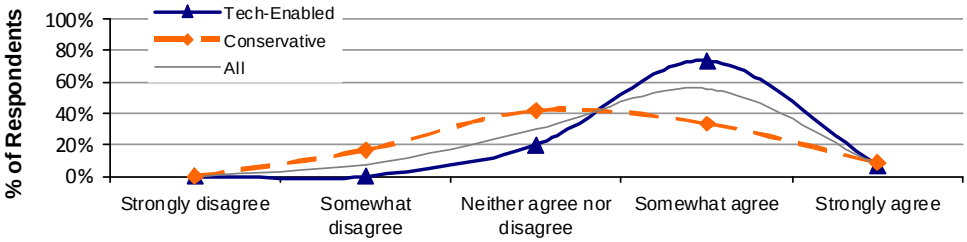
Q6.2 The current skill sets of my university-qualified engineers will meet the majority of my skill requirements for the next 5-10 years

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	7%	13%	7%	53%	20%	Tech-Enabled	20%	7%	73%
No/Not Sure	0%	0%	25%	58%	17%	Conserv.	0%	25%	75%
ALL	**4%**	**7%**	**15%**	**56%**	**19%**	**ALL**	**11%**	**15%**	**74%**



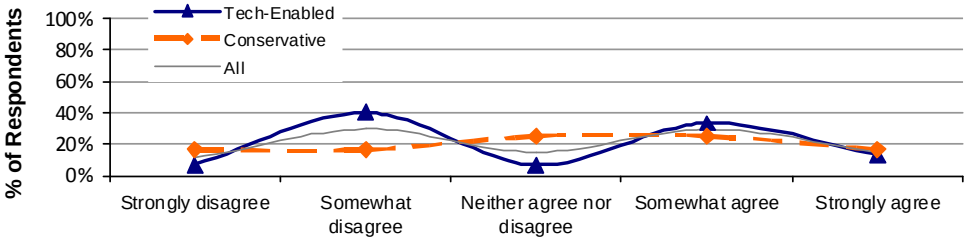
Q6.2 In general university graduates understand the latest technologies applicable in their field

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	0%	0%	20%	73%	7%	Tech-Enabled	0%	20%	80%
No/Not Sure	0%	17%	42%	33%	8%	Conserv.	17%	42%	42%
ALL	**0%**	**7%**	**30%**	**56%**	**7%**	**ALL**	**7%**	**30%**	**63%**



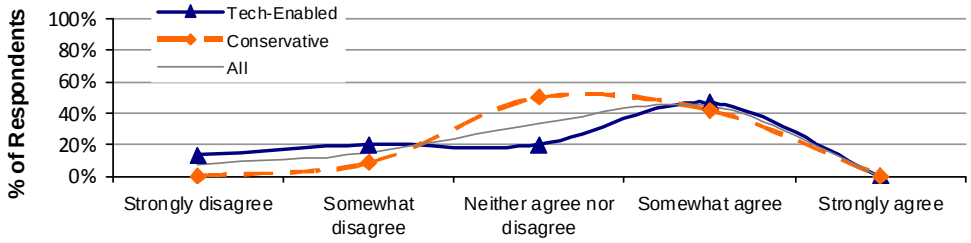
Q6.2 My company is or would consider employing candidates with post-graduate experience (i.e Masters, PhD)

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	7%	40%	7%	33%	13%	Tech-Enabled	47%	7%	47%
No/Not Sure	17%	17%	25%	25%	17%	Conserv.	33%	25%	42%
ALL	**11%**	**30%**	**15%**	**30%**	**15%**	**ALL**	**41%**	**15%**	**44%**



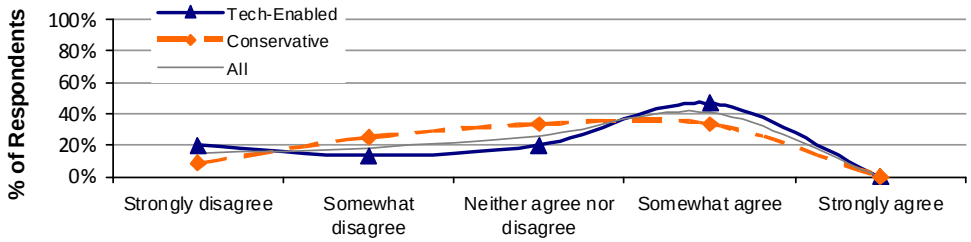
Q6.2 Current training programs for engineers equip students with the skills required for my business

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	13%	20%	20%	47%	0%	Tech-Enabled	33%	20%	47%
No/Not Sure	0%	8%	50%	42%	0%	Conserv.	8%	50%	42%
ALL	**7%**	**15%**	**33%**	**44%**	**0%**	**ALL**	**22%**	**33%**	**44%**



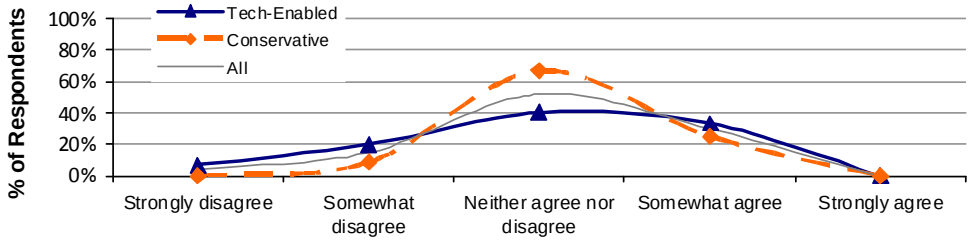
Q6.2 University graduates have a sufficient level of understanding of project management concepts

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	20%	13%	20%	47%	0%	Tech-Enabled	33%	20%	47%
No/Not Sure	8%	25%	33%	33%	0%	Conserv.	33%	33%	33%
ALL	**15%**	**19%**	**26%**	**41%**	**0%**	**ALL**	**33%**	**26%**	**41%**



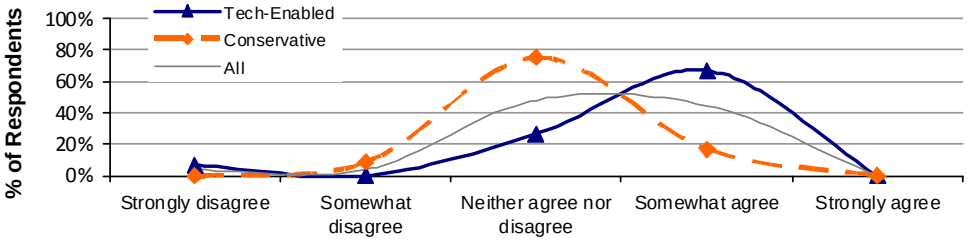
Q6.2 The currently available engineering courses develop pragmatic engineers (able to implement practical engineering solutions)

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	7%	20%	40%	33%	0%	Tech-Enabled	27%	40%	33%
No/Not Sure	0%	8%	67%	25%	0%	Conserv.	8%	67%	25%
ALL	**4%**	**15%**	**52%**	**30%**	**0%**	**ALL**	**19%**	**52%**	**30%**



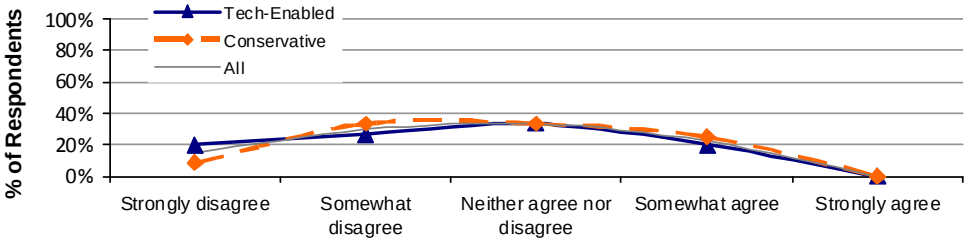
Q6.2 The currently available engineering courses develop innovative engineers (able to generate innovative engineering solutions)

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	7%	0%	27%	67%	0%	Tech-Enabled	7%	27%	67%
No/Not Sure	0%	8%	75%	17%	0%	Conserv.	8%	75%	17%
ALL	**4%**	**4%**	**48%**	**44%**	**0%**	**ALL**	**7%**	**48%**	**44%**



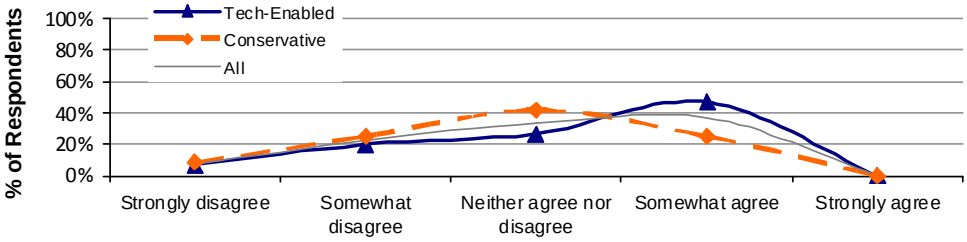
Q6.2 University graduates have a sufficient level of awareness of business operations

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	20%	27%	33%	20%	0%	Tech-Enabled	47%	33%	20%
No/Not Sure	8%	33%	33%	25%	0%	Conserv.	42%	33%	25%
ALL	**15%**	**30%**	**33%**	**22%**	**0%**	**ALL**	**44%**	**33%**	**22%**



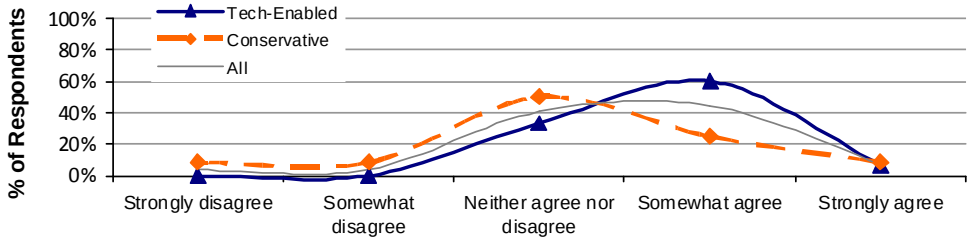
Q6.2 I am aware of training programs offered by the University to upskill my employees

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	7%	20%	27%	47%	0%	Tech-Enabled	27%	27%	47%
No/Not Sure	8%	25%	42%	25%	0%	Conserv.	33%	42%	25%
ALL	**7%**	**22%**	**33%**	**37%**	**0%**	**ALL**	**30%**	**33%**	**37%**



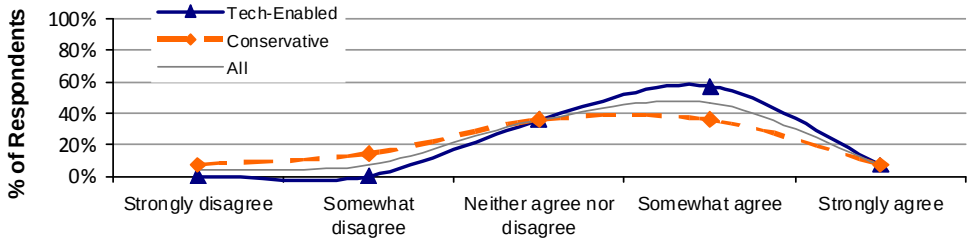
Q6.2 I would consider approaching the University to improve my understanding of emerging technologies

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	0%	0%	33%	60%	7%	Tech-Enabled	0%	33%	67%
No/Not Sure	8%	8%	50%	25%	8%	Conserv.	17%	50%	33%
ALL	**4%**	**4%**	**41%**	**44%**	**7%**	**ALL**	**7%**	**41%**	**52%**



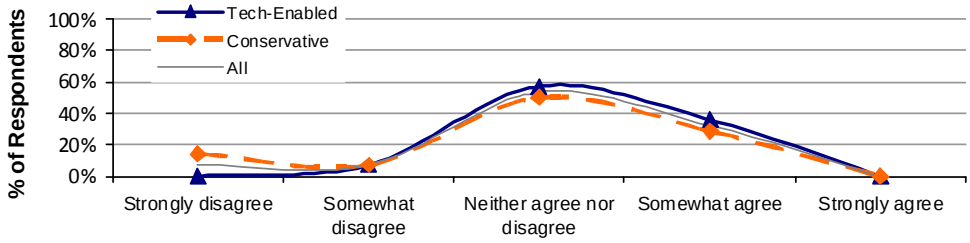
Q7.2 Currently the available training for design and drafting equips students with the skills required to operate the drawing packages and technologies used by my business

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	0%	0%	36%	57%	7%	Tech-Enabled	0%	36%	64%
No/Not Sure	7%	14%	36%	36%	7%	Conserv.	21%	36%	43%
ALL	**4%**	**7%**	**36%**	**46%**	**7%**	**ALL**	**11%**	**36%**	**54%**



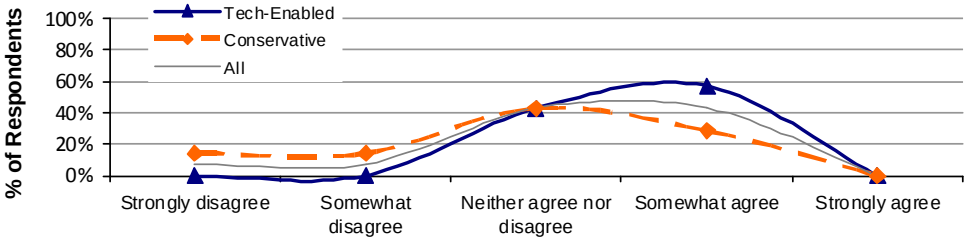
Q7.2 The currently available design courses develop pragmatic design skills (i.e. able to produce fit for purpose designs)

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	0%	7%	57%	36%	0%	Tech-Enabled	7%	57%	36%
No/Not Sure	14%	7%	50%	29%	0%	Conserv.	21%	50%	29%
ALL	**7%**	**7%**	**54%**	**32%**	**0%**	**ALL**	**14%**	**54%**	**32%**



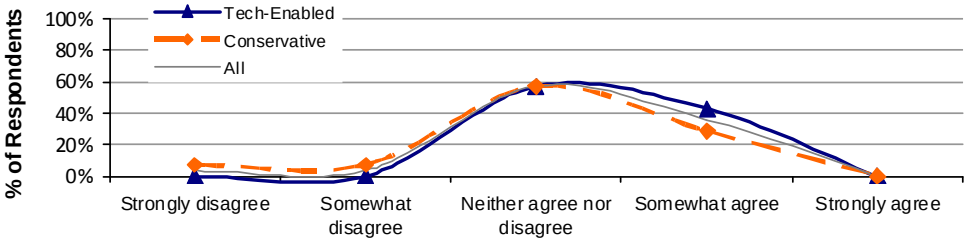
Q7.2 The currently available design courses develop designers who are able to implement innovative design solutions

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	0%	0%	43%	57%	0%	Tech-Enabled	0%	43%	57%
No/Not Sure	14%	14%	43%	29%	0%	Conserv.	29%	43%	29%
ALL	**7%**	**7%**	**43%**	**43%**	**0%**	**ALL**	**14%**	**43%**	**43%**



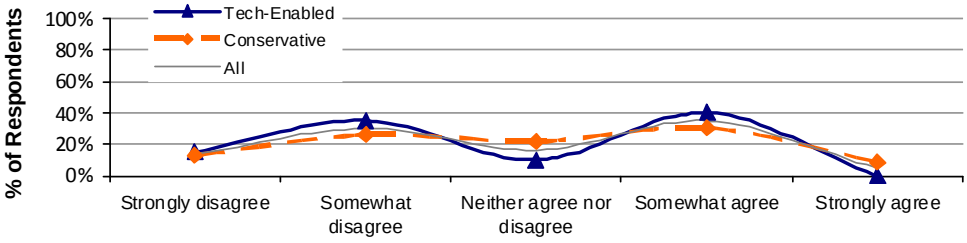
Q7.2 Currently post-trade courses equip technicians/technical officers with a relevant and practical understanding of emerging technologies

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	0%	0%	57%	43%	0%	Tech-Enabled	0%	57%	43%
No/Not Sure	7%	7%	57%	29%	0%	Conserv.	14%	57%	29%
ALL	**4%**	**4%**	**57%**	**36%**	**0%**	**ALL**	**7%**	**57%**	**36%**



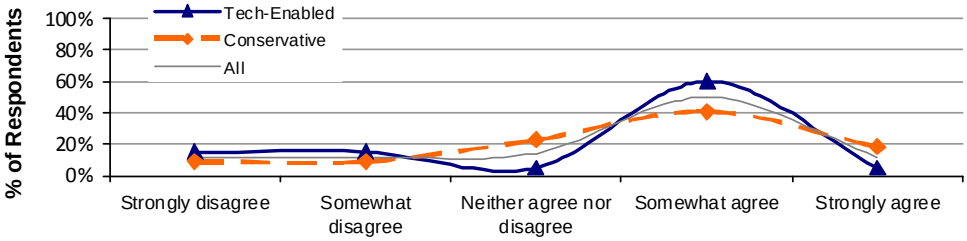
Q8.1 My workforce has the required level of business development skills (communication customer awareness, service, product knowledge, market awareness) to meet the businesses needs now and for the next 5-10 years

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	15%	35%	10%	40%	0%	Tech-Enabled	50%	10%	40%
No/Not Sure	13%	26%	22%	30%	9%	Conserv.	39%	22%	39%
ALL	**14%**	**30%**	**16%**	**35%**	**5%**	**ALL**	**44%**	**16%**	**40%**



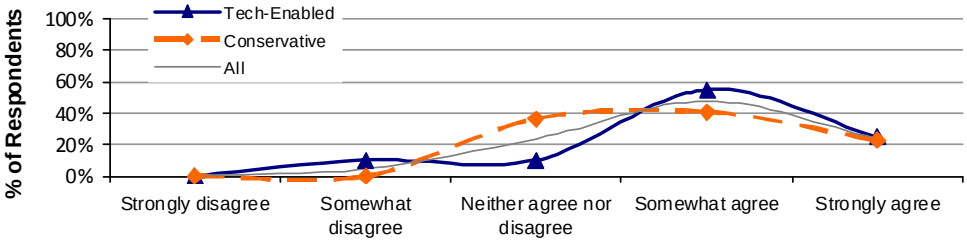
Q8.1 I am aware of training that can be provided to my employees to develop their business building skills

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	15%	15%	5%	60%	5%	Tech-Enabled	30%	5%	65%
No/Not Sure	9%	9%	23%	41%	18%	Conserv.	18%	23%	59%
ALL	**12%**	**12%**	**14%**	**50%**	**12%**	**ALL**	**24%**	**14%**	**62%**



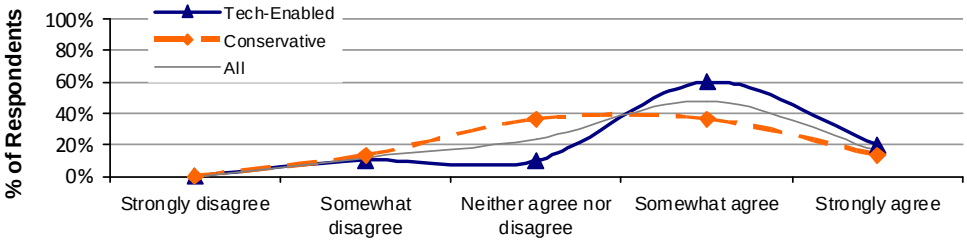
Q8.1 Emerging technologies relating to communication, the internet and e-business has changed or is expected to change the way my business communicates with current and potential customers

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	0%	10%	10%	55%	25%	Tech-Enabled	10%	10%	80%
No/Not Sure	0%	0%	36%	41%	23%	Conserv.	0%	36%	64%
ALL	**0%**	**5%**	**24%**	**48%**	**24%**	**ALL**	**5%**	**24%**	**71%**



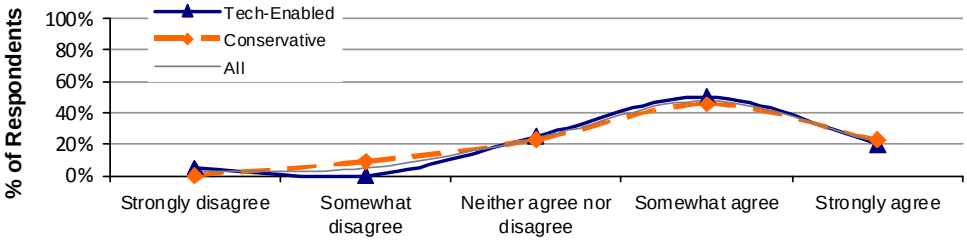
Q8.1 Emerging technologies relating to communication the internet and e-business will change the skills required by my employees to service customers and grow my business

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	0%	10%	10%	60%	20%	Tech-Enabled	10%	10%	80%
No/Not Sure	0%	14%	36%	36%	14%	Conserv.	14%	36%	50%
ALL	**0%**	**12%**	**24%**	**48%**	**17%**	**ALL**	**12%**	**24%**	**64%**



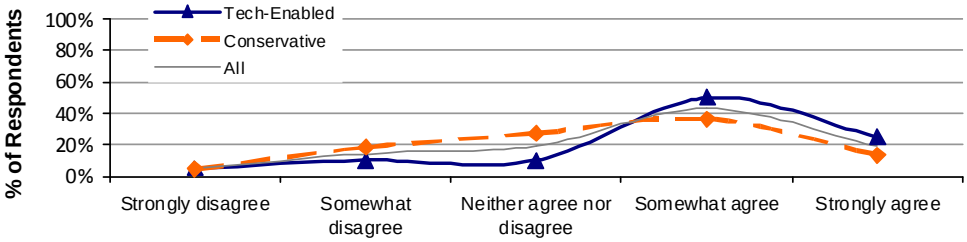
Q8.3 In the next ten years skills relating to energy management will become more important to my business

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	5%	0%	25%	50%	20%	Tech-Enabled	5%	25%	70%
No/Not Sure	0%	9%	23%	45%	23%	Conserv.	9%	23%	68%
ALL	**2%**	**5%**	**24%**	**48%**	**21%**	**ALL**	**7%**	**24%**	**69%**



Q8.3 Issues relating to sustainability will potentially provide new market opportunities for my company

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	5%	10%	10%	50%	25%	Tech-Enabled	15%	10%	75%
No/Not Sure	5%	18%	27%	36%	14%	Conserv.	23%	27%	50%
ALL	**5%**	**14%**	**19%**	**43%**	**19%**	**ALL**	**19%**	**19%**	**62%**



Q8.3 My company is pursuing "Green" options to meet customer and/or community expectations

Using	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree	Class	Disagree	Neither agree nor disagree	Agree
Yes	0%	15%	25%	35%	25%	Tech-Enabled	15%	25%	60%
No/Not Sure	9%	36%	45%	9%	0%	Conserv.	45%	45%	9%
ALL	**5%**	**26%**	**36%**	**21%**	**12%**	**ALL**	**31%**	**36%**	**33%**